BUREAU OF ENERGY AND TECHNOLOGY POLICY

Slides for the morning and afternoon sessions are in separate decks. This is the **morning** deck.

November 4, 2022

Alternative Fuels

Technical Session 6
CT 2022 Comprehensive Energy Strategy

Session is being recorded

Logistics & Housekeeping

- **This session is being recorded**
- **Please include your name and affiliation (if any) in your Zoom icon**
- **Please turn off your audio and video except when speaking**
- **To enter the queue to provide verbal comment, use Zoom's *raise hand* feature (more details will be provided later)**
- **Use the chat function to ask questions about presentations or procedures.**

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Today's Agenda – Morning

Click on an agenda section heading to jump to the relevant slides

General Introduction	9:00-9:05 am
Topic Introduction	9:05-9:30 am
Public Comments	9:30-9:45 am
Overview of Alternative Fuels	9:45-10:15 am
Q&A	10:15-10:30 am
Benefits of Alternative Fuels	10:30-11:45 am
Q&A	11:45 am-12:00 pm
----------LUNCH----------	12:00-1:00 pm

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Today's Agenda – Afternoon

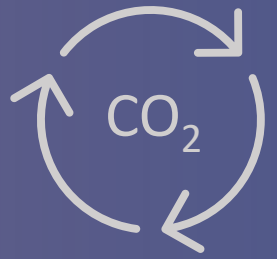
Slides for the afternoon session are in a separate deck

Challenges with Alternative Fuels	1:00-2:35 pm
Q&A	2:35-2:50 pm
Alternative Fuels – Strategies for Optimal Use	2:50-3:50 pm
Q&A	3:50-4:05 pm
Public Comment	4:05-4:20 pm
Wrap Up	4:20-4:30 pm

UPCOMING TECHNICAL SESSIONS

Other sessions to be announced for late November

- Natural Gas Planning & Policies



- Carbon Pricing & Low-Carbon Incentives

More information on the CES webpage: https://portal.ct.gov/DEEP/Energy/Comprehensive-Energy-Plan/Comprehensive-Energy-Strategy

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Technical Session	Meeting Date(s)	Deadline for Written Comments
4	No meeting held	Nov. 21, 2022, at 5:00 p.m. ET
5	Nov. 3, 2022 9 a.m. - 3 p.m. ET (Today)	Nov. 21, 2022, at 5:00 p.m. ET
6	Nov. 4, 2022 9 a.m. - 5 p.m. ET	Nov. 21, 2022, at 5:00 p.m. ET

Written Comment Opportunities

- **After each technical session DEEP is accepting written comments**
- **Please see the October 19th notice and the October 28th notice for submission instructions and specific questions for which DEEP is seeking responses**
- **More information on the CES web page: https://portal.ct.gov/DEEP/Energy/Comprehensive-Energy-Plan/Comprehensive-Energy-Strategy**

BUREAU OF ENERGY AND TECHNOLOGY POLICY

WELCOME & INTRODUCTIONS

Thanks for joining our technical session today!

Comprehensive Energy Strategy Scope & Objectives

- **Scope**: electricity, thermal energy, and fuels for transportation

- **Objectives:**
  - Examine future energy needs in the state and identify opportunities to reduce costs, ensure reliable energy availability, and mitigate public health and environmental impacts of CT's energy use
  - Provide recommendations for legislative and administrative actions to aid in achievement of interrelated environmental, economic, security, and reliability goals

BETP Mission: to manage energy, telecommunication, and broadband policy issues and program deployment with the goal of establishing a clean, economical, equitable, resilient, and reliable energy future for all residents.

BUREAU OF ENERGY AND TECHNOLOGY POLICY

DEEP's Approach to the 2022 CES

5 Key Lenses

- **Climate** – meeting greenhouse gas reduction obligations under Global Warming Solutions Act
- **Equity** – energy decisions that produce equitable outcomes
- **Affordability** – energy decisions that produce affordable outcomes
- **Economic development** – workforce development; economic competitiveness
- **Reliability & Resilience** – energy system improvements and load balancing

Key Strategies

- Build on and/or modify findings and recommendations of 2013 and 2018 CESs
- Consider emerging issues not addressed in a prior CES
- Rely on results from recent, major quantitative studies where appropriate rather than duplicate efforts

3 Key Factors

- The carbon intensity of the electric grid
- Need for emission-reduction solutions that facilitate climate change adaptation, resilience, and energy security
- Fuel price volatility

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Tentative CES Development Timeline

- **September 2022** – Technical Sessions 1-3
- **November 2022** – Technical Sessions 5-8
- **November 2022 – January 2023** – Drafting & Public Comment Periods for at least 3 White Papers
  - White papers to be based on topics covered in technical sessions
- **Q1 & Q2 of 2023** – CES Drafting, Public Comment Opportunities, & Listening Sessions

Technical Session Topics

1. Hard-to-Decarbonize End Uses
2. Heat Pump Market Barriers & Strategies
3. Building Thermal Decarbonization Support Strategies
4. Building Thermal Decarbonization – Economic Potential & Technology Targets [written comment opportunity only – no live technical session]
5. Electric Demand Response
6. Alternative Fuels
7. Natural Gas Planning & Policies
8. Carbon Pricing & Low-Carbon Incentives

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Topic Introduction

Jeff Howard – Bureau of Energy & Technology Policy – CT DEEP

James Troderman & Mindi Farber-DeAnda – US Energy Information Administration (EIA)

(speaker order may vary)

BUREAU OF ENERGY AND TECHNOLOGY POLICY

BUREAU OF ENERGY AND
TECHNOLOGY POLICY

November 4, 2022

Alternative Fuels in Context

Alternative fuels in context

Definition and conception of *alternative fuels* varies

For this set of slides, DEEP is excluding electricity from solar, wind, hydro

Helpful to see alternative fuels in context of overall CT fuel production, consumption, expenditures, GHG emissions

- In most cases, alternative fuels represent small fraction

But CT data on AFs is incomplete, and data quality often is poor

- AFs often are blended with fossil fuels, and public data streams about quantities often are inadequate

Alternative fuels facilities in CT

One biodiesel production plant – The largest in New England, produces about 30 million gallons annually

One wood biomass facility – Uses wood reclaimed from construction, demolition, sustainable forestry, and land clearing to produce electricity

One anaerobic digestion facility – Produces biogas from municipal organic waste and uses it to generate electricity

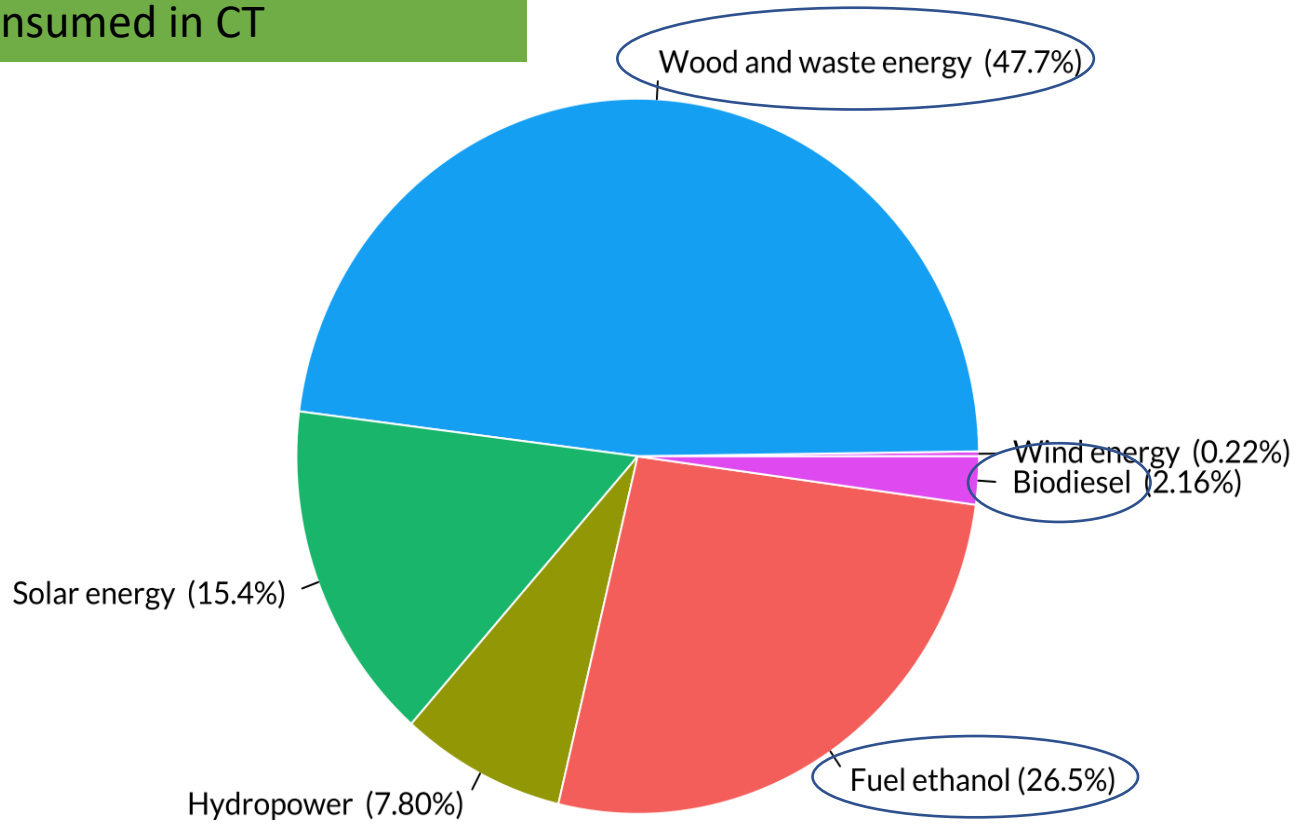
Greenleaf POWER

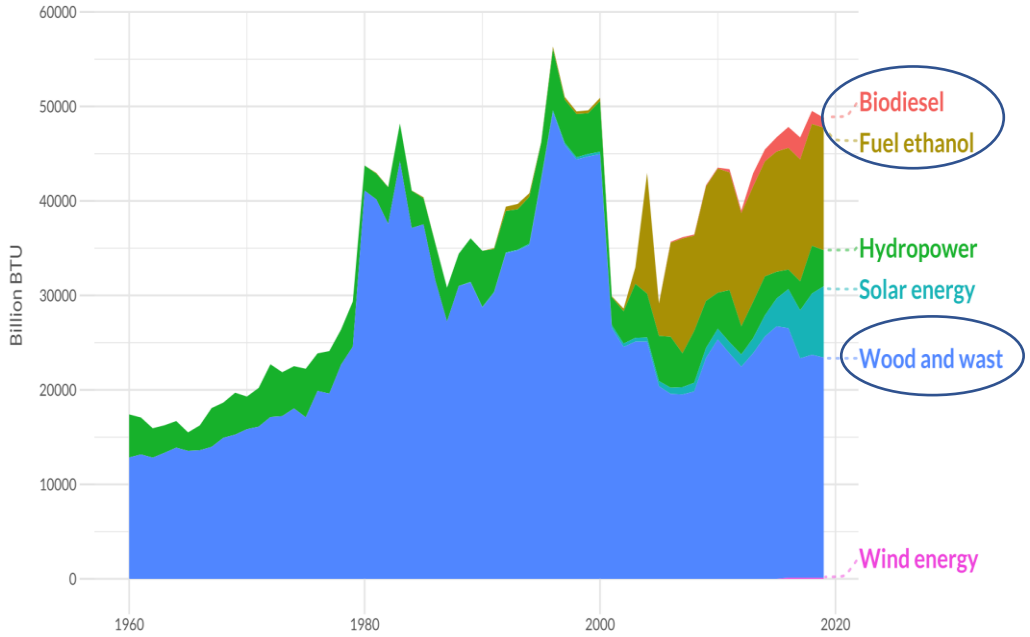
QUANTUM BIOPOWER

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Renewable Energy Consumption

Alternative fuels represent about three-fourths of renewable energy consumed in CT

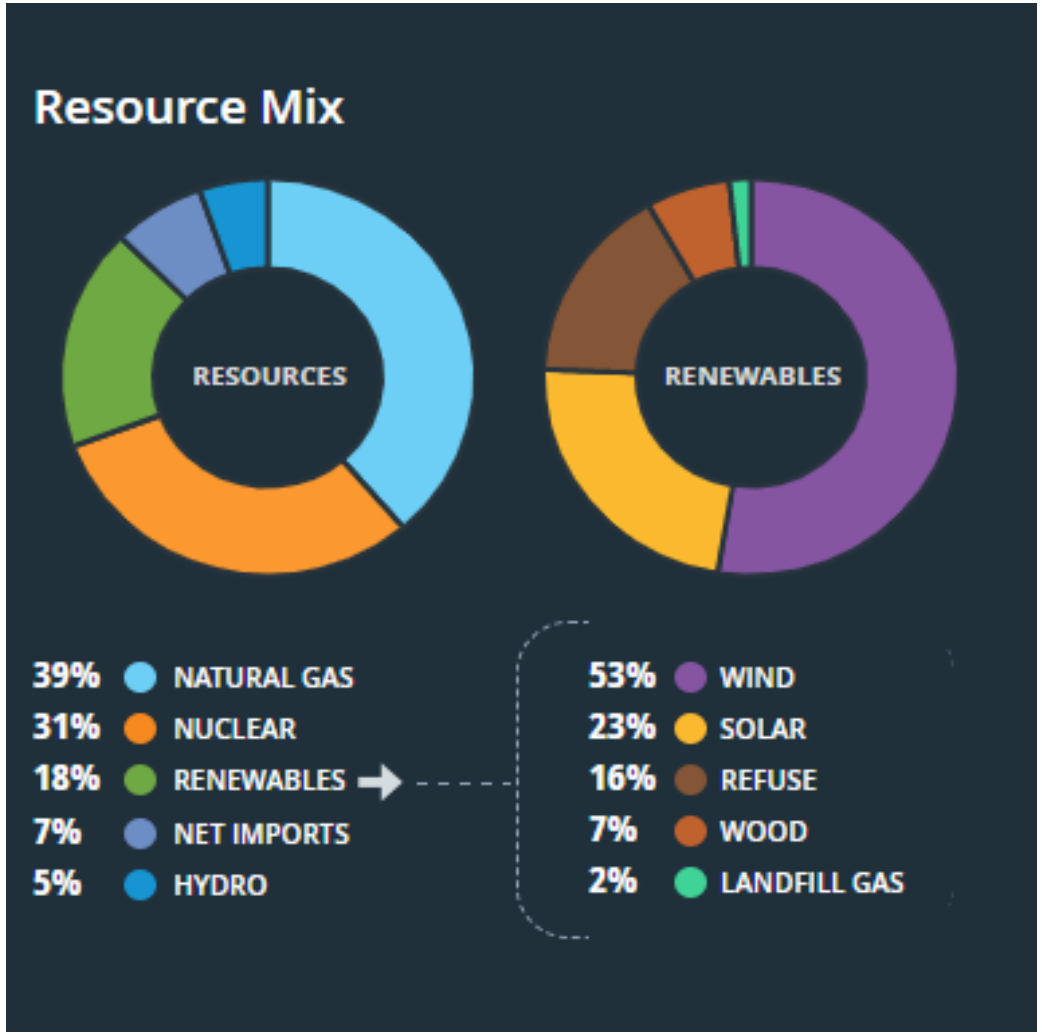




Data from Energy Information Administration • State Energy Data System

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Regional electricity grid



Along with other New England states, Connecticut consumes electricity from a regional electric grid

The major resources employed:

Natural gas (39%, including some RNG)

Nuclear (31%)

Renewables (18%), most of which is wind and solar but includes 3 alternative fuels:

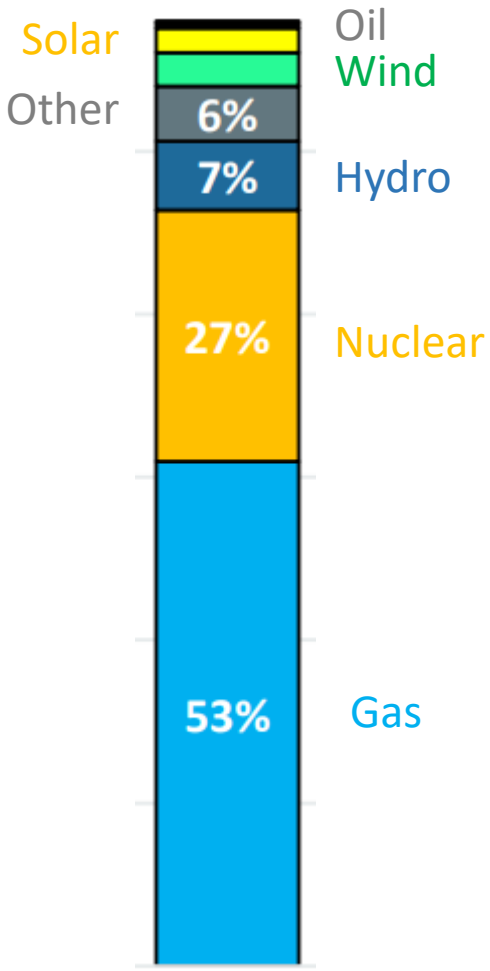
- Refuse
- Wood
- Landfill gas/RNG

~4.5% of overall resource mix

NOTE: DEEP recognized after the Nov. 4 technical meeting that data on this slide was for a particular point in time in early November and not representative of the average grid mix. See the next slide for comparison.

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Regional electricity grid



Generation within region

Source

Gas	**46%**
Nuclear	**23%**
Renewables	**10%**
Wind	3%
Refuse	3%
Wood	2%
Solar	2%
Landfill Gas	0.4%
Hydro	**5%**
Other	**1%**
Net imports	**16%**

Generation including imports

Source

As in graphic in previous slide, *net imports* not broken down by category. 73% is from Quebec, and that fraction is dominated by hydro.

NOTE: This slide was inserted following the Nov. 4 meeting for comparison with the narrower data presented in the previous slide. It represents the average ISO-NE grid mix for 2021.

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Consumption of petroleum and methane

Petroleum – 52 million barrels (2020)

- Vehicles used about 70% of this – primarily gasoline and diesel fuel
  - Typically 10% ethanol in gasoline, <5% biodiesel in diesel
- About 39% of households used fuel oil for heating
  - 5-7% biodiesel?

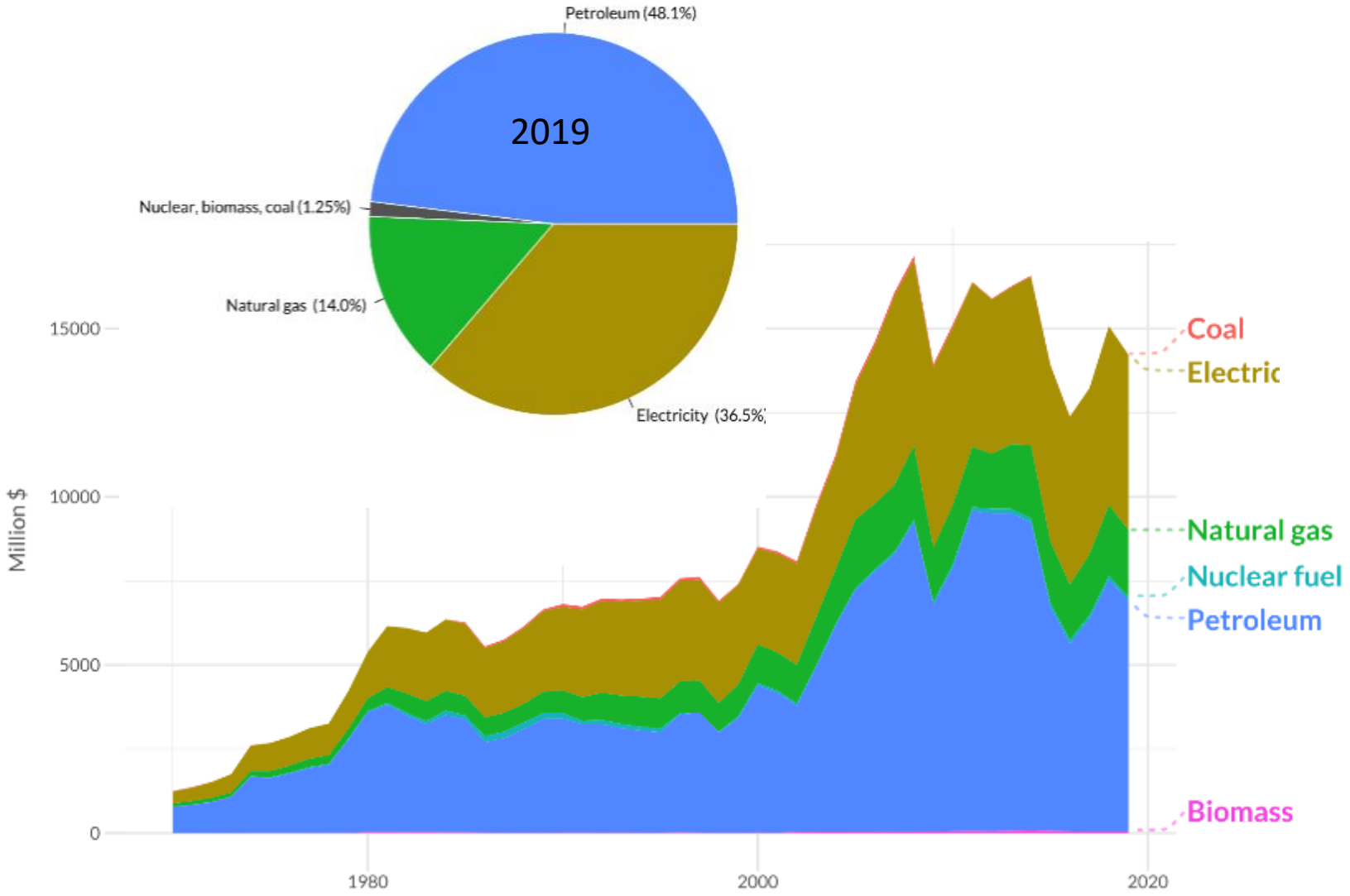
Methane – 289 billion cubic feet (2020)

- Electric power sector – 60%
- Commercial sector – 20%
- Residential sector – 16%
- Industrial, transportation, other – 4%

CT's supply of methane contains an unknown but presumably very small percentage of RNG – in regional electricity generation, about 0.3%

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Energy Expenditures



Connecticut spent over $13.5 billion on all forms of energy in 2019

Expenditures increased significantly until early 2000s

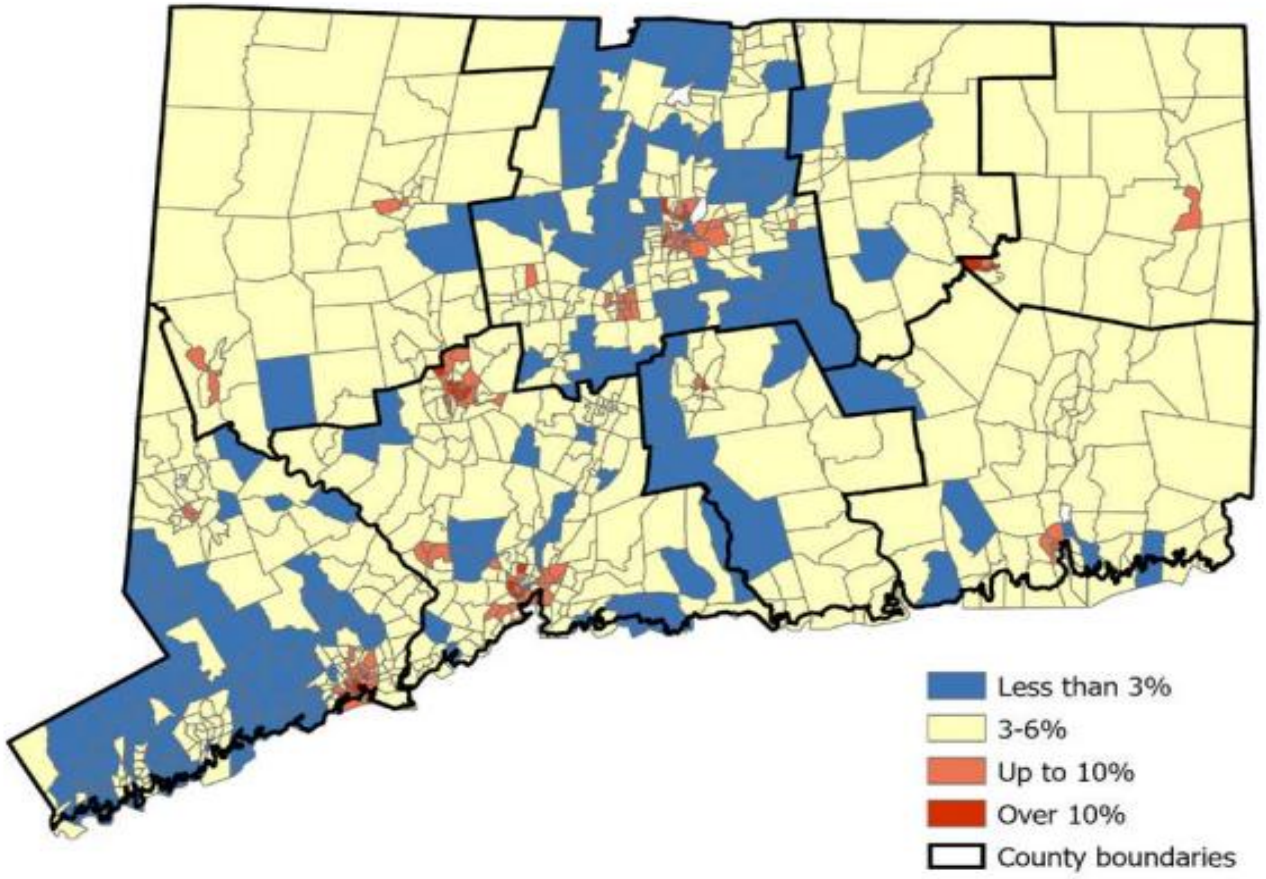
Petroleum includes ethanol and biodiesel

Electricity reflects small fraction of RNG

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Energy Affordability – Building Energy Burden

Energy Burden by CT Census Tract



Building energy burden = percentage of household income spent on energy (heating + electricity)

Most commonly used affordability threshold: 6%

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Source: VIEC, Mapping Household Energy & Transportation Affordability in Connecticut, October 2020

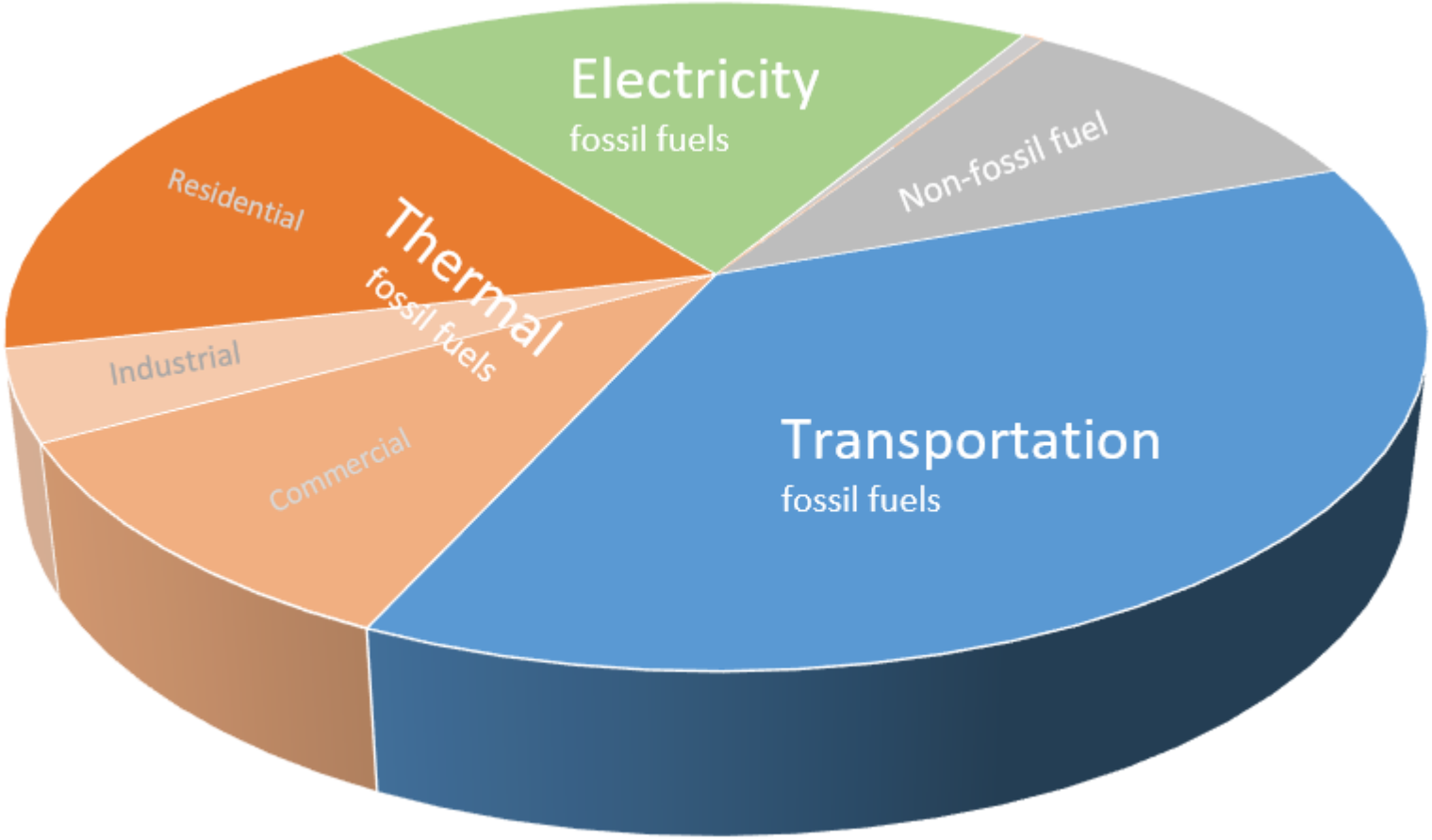
Greenhouse gas emissions (2018)

90% of all CT GHG emissions are from combustion of fossil fuels (2018)

About one-third of all CT emissions are from **transportation** use of fossil fuels

About one-third are from **thermal** use of fossil fuels

About one-fifth are from use of fossil fuels in generating **electricity**



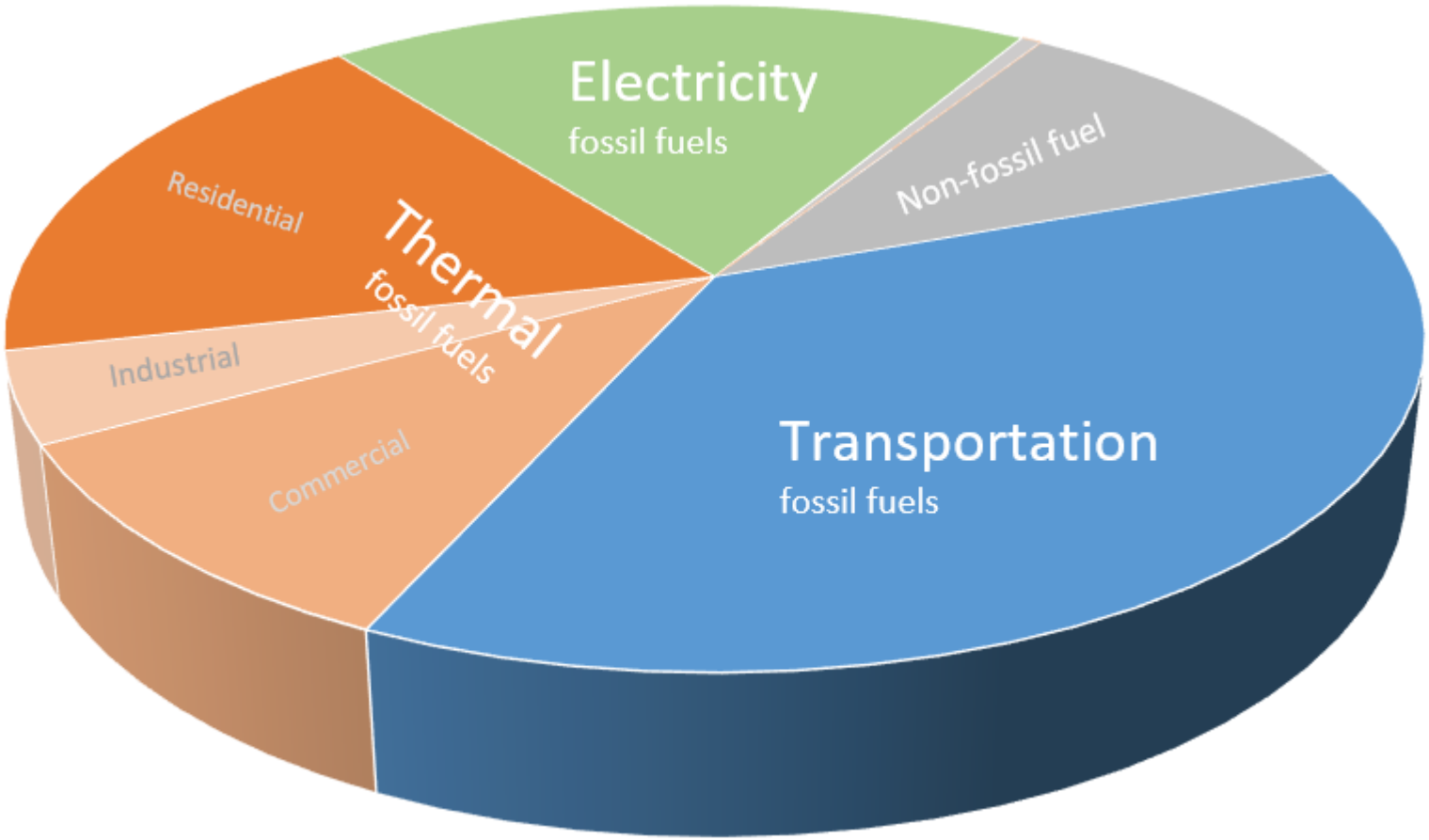
BUREAU OF ENERGY AND TECHNOLOGY POLICY

In EPA data DEEP used for 2018 GHG inventory:

- Ethanol blended with gasoline was reflected (12.9 trillion BTUs)
- Biodiesel blended with diesel fuel and heating oil was not

In EPA data for 2019 inventory:

- Biodiesel is expected to be incorporated, but reported figure of 1.1 trillion BTU appears to be quite low (by 4-5X)
- And DEEP will have to estimate division between transportation and thermal



CT standards and alternative fuels

Thermal biofuel blending mandate

- Public Act 21-181: Mandatory biofuel content in heating oil
- Minimum 5% in 2022 → 50% in 2035

Renewable Portfolio Standard

- 25% in 2018 → 33% in 2022 → 48% in 2030
- Biogas derived from biological sources qualifies as Class I

Regional Greenhouse Gas Initiative

- Declining cap on emissions from power generation; regional market for emission credits; 50% reduction since 2009
- But counts carbon emissions at stack, so does not prompt uptake of alternative fuels

Zero-carbon electricity grid

- Public Act 22-5: Mandatory by 2040
- Role of alternative fuels not yet determined

Zero Emission Vehicle MOU and Action Plan

- CT one of numerous states committed to promoting ZEVs and ZEV infrastructure
- In addition to battery vehicles, covers fuel-cell vehicles and hydrogen fueling

Final thoughts

Use of alternative fuels is presently fairly low – but could grow significantly

DEEP recognizes need for more information on the following:

- Quantity of **RNG** in the methane supply and consumed by each sector
- **Biodiesel** consumed by each sector
- Potential impacts on **energy affordability and resiliency** as more alternative fuels are consumed
- **Economic impacts** of expanding use of alternative fuels in Connecticut

BUREAU OF ENERGY AND
TECHNOLOGY POLICY

US Energy Information Administration (EIA)

Recent Trends and EIA's Outlook for Petroleum and Natural Gas in the United States

For:

Connecticut Comprehensive Energy Strategy Session

November 4, 2022

By:

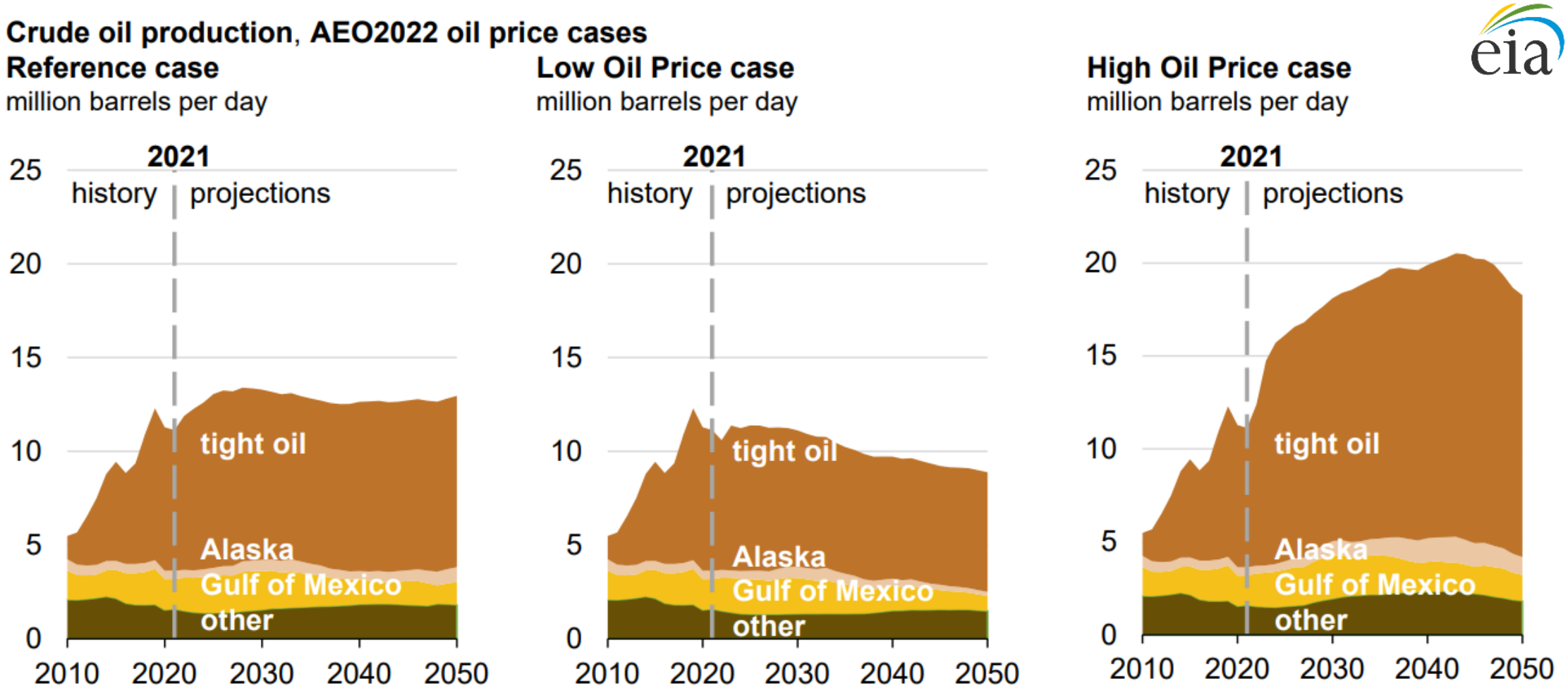
Jimmy Troderman and Mindi Farber-DeAnda

U.S. Energy Information Administration

EIA mission: independent statistics and analysis

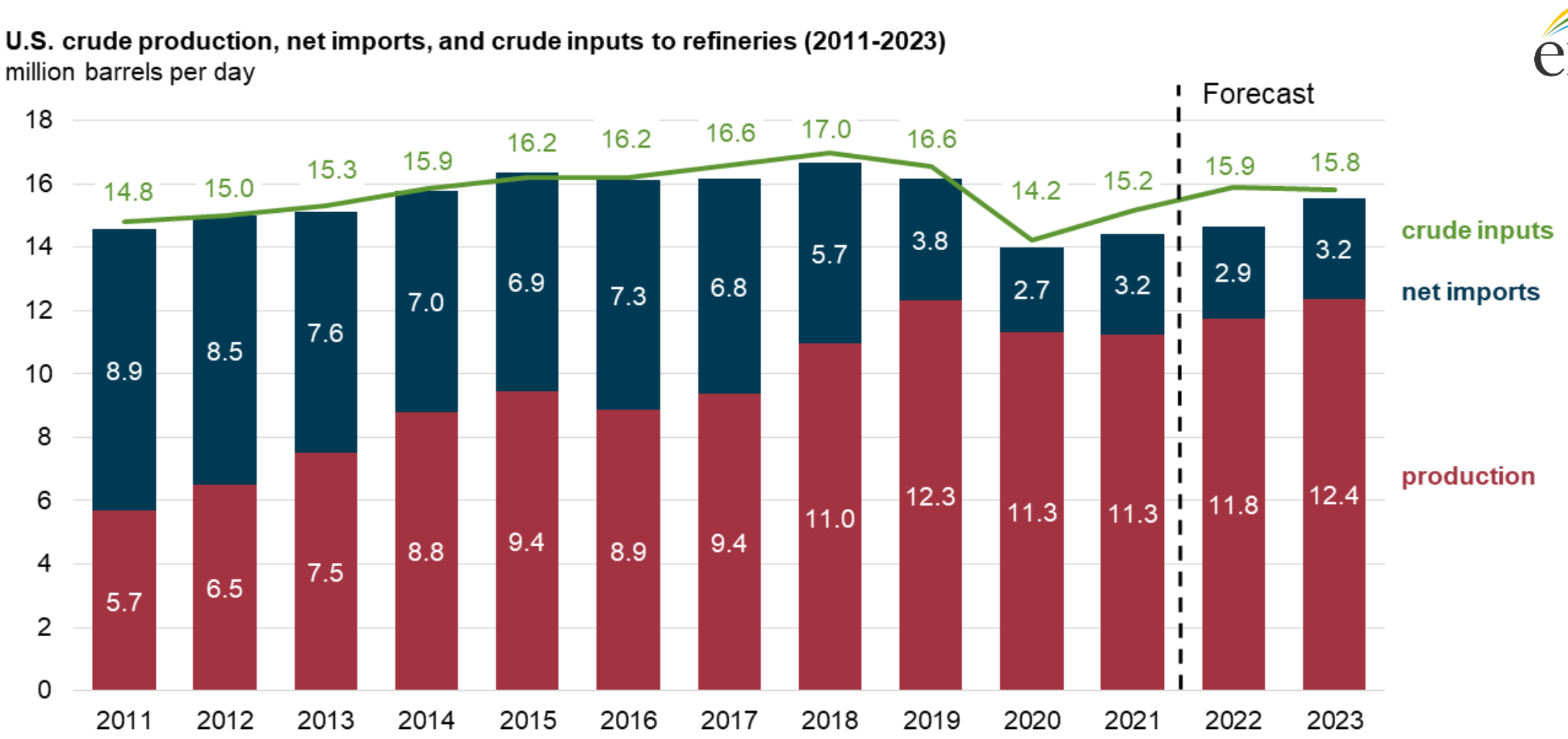
- EIA is an independent office within the U.S. Department of Energy. EIA was created by the U.S. Congress in 1977
- EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment
- EIA is U.S. primary federal gov't authority on energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the U.S. Government
- EIA does not propose or advocate any policy positions

U.S. crude oil production history and outlook (2010-2050)



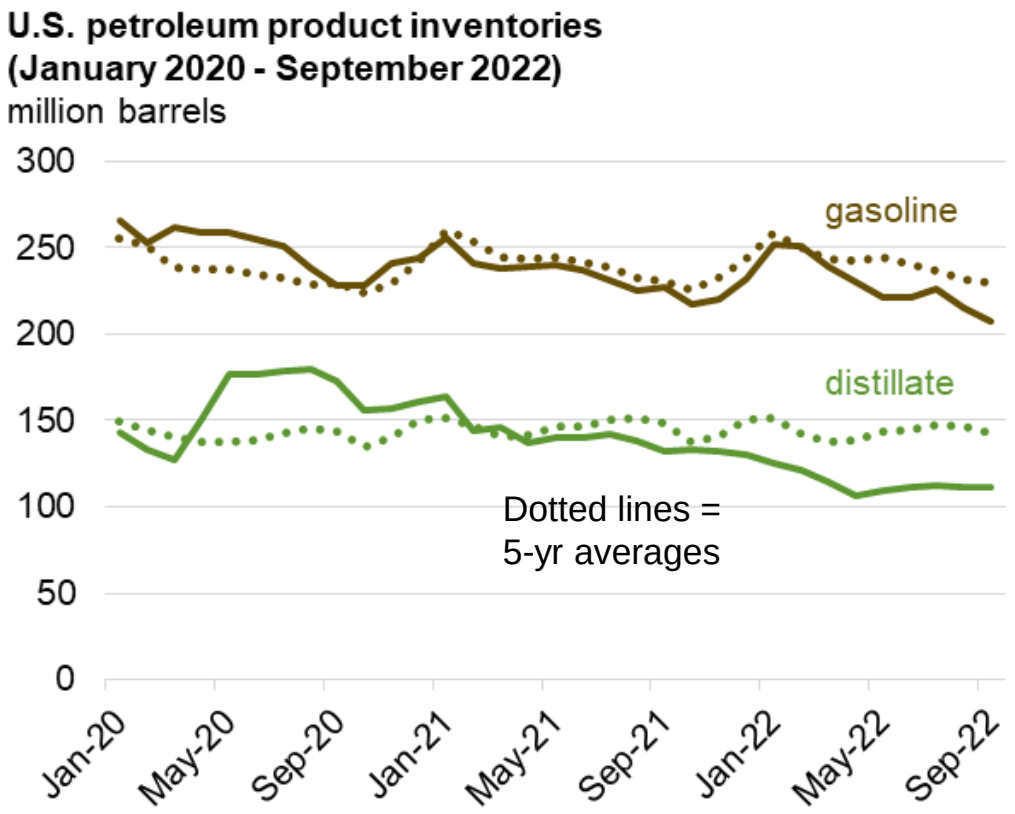
Source: *U.S. EIA, Annual Energy Outlook 2022*

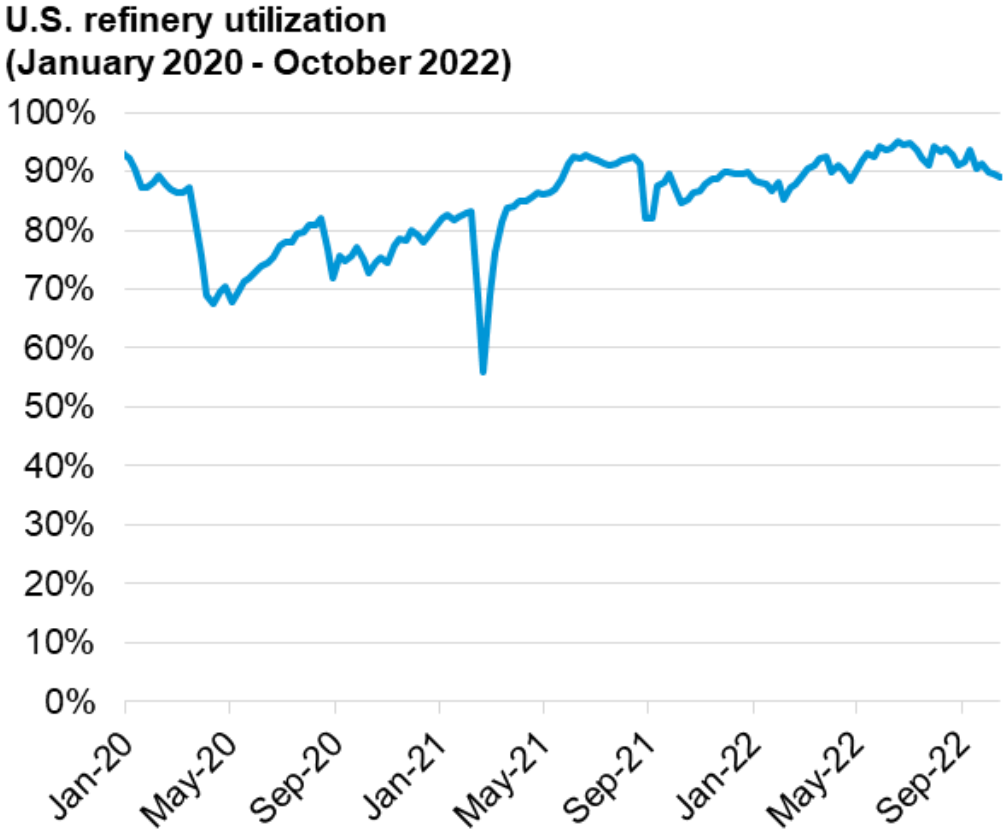
U.S. production and refinery runs have recovered below 2019 levels



Source: U.S. EIA, *Petroleum Supply Monthly, Short-Term Energy Outlook* October 2022

Product inventories are down despite increasing refinery utilization

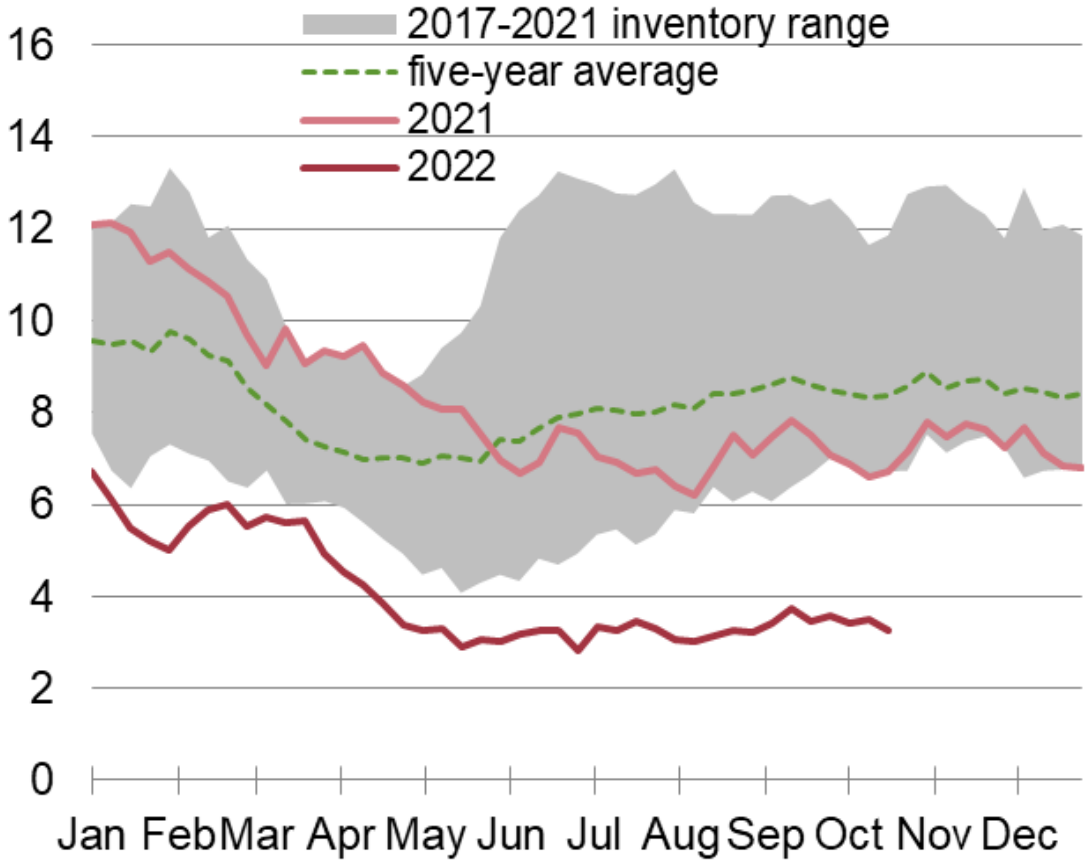




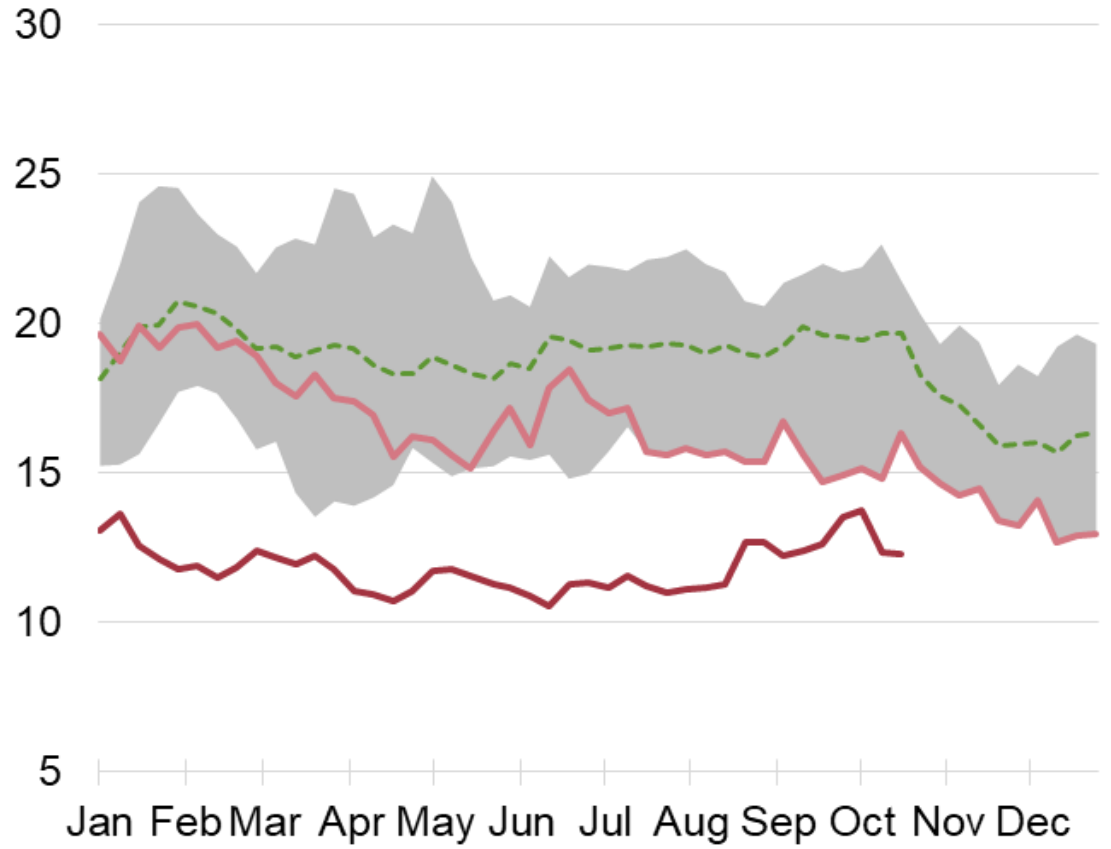
Source: U.S. EIA, *Weekly Petroleum Status Report, Petroleum Supply Monthly, Short-Term Energy Outlook* October 2022

Distillate inventories in New England and Europe

New England distillate inventories
million barrels



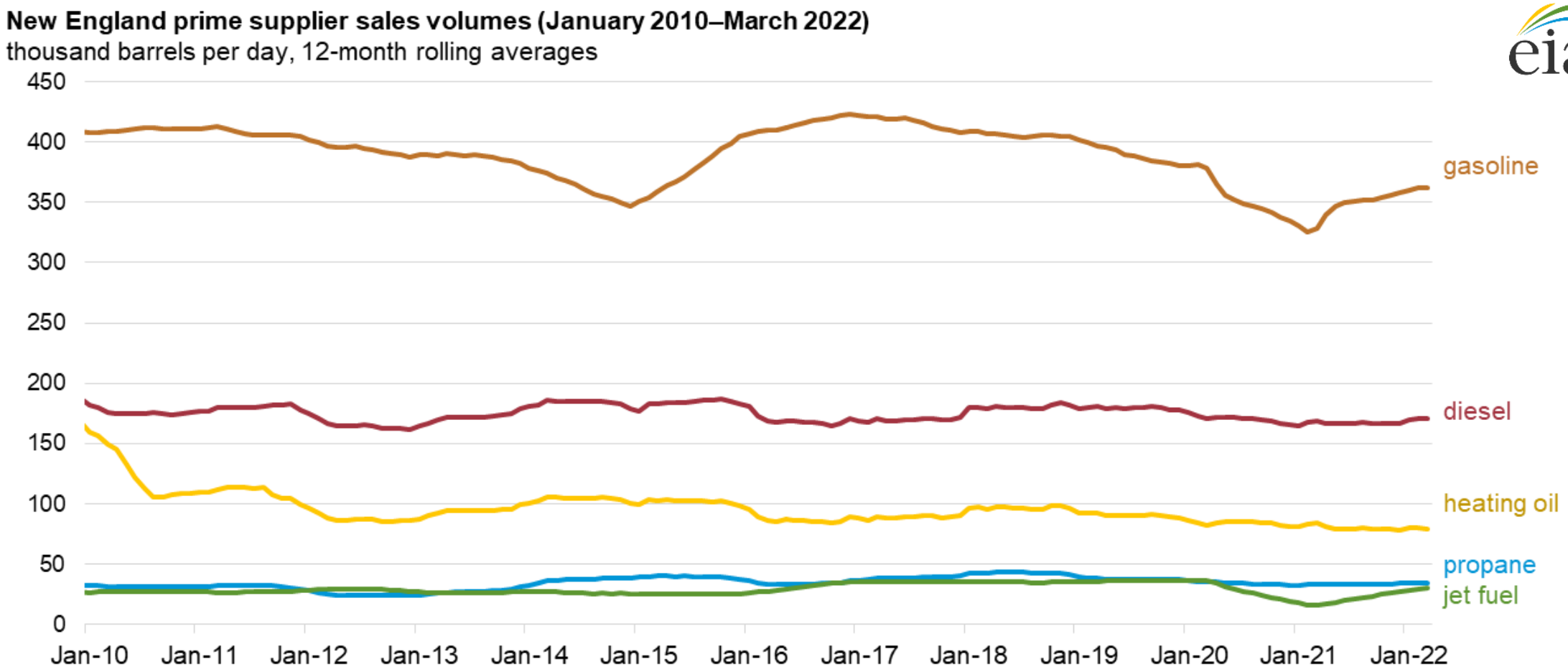
ARA* distillate inventories
million barrels



Source: U.S. EIA, *Weekly Petroleum Status Report*

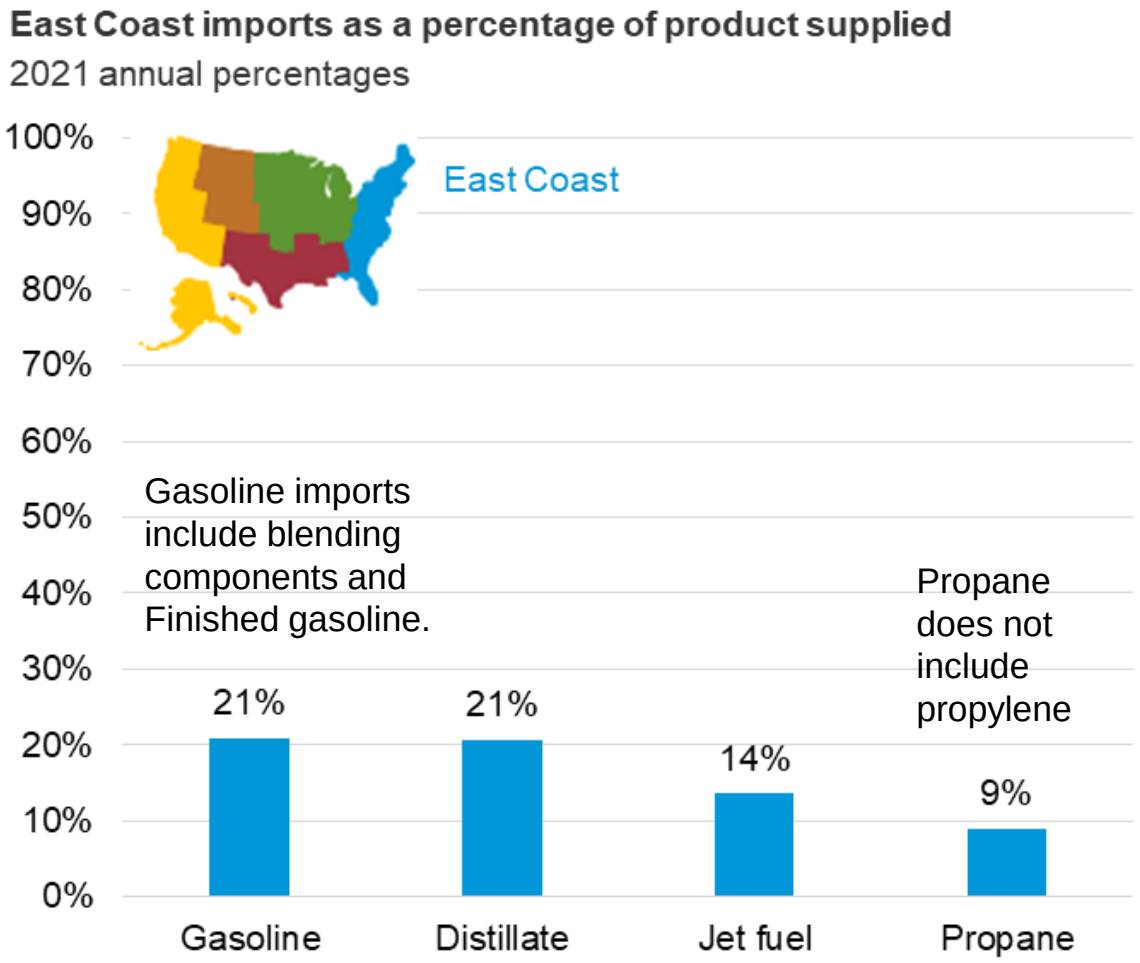
* ARA = Amsterdam, Rotterdam, and Antwerp ports in Northwest Europe.

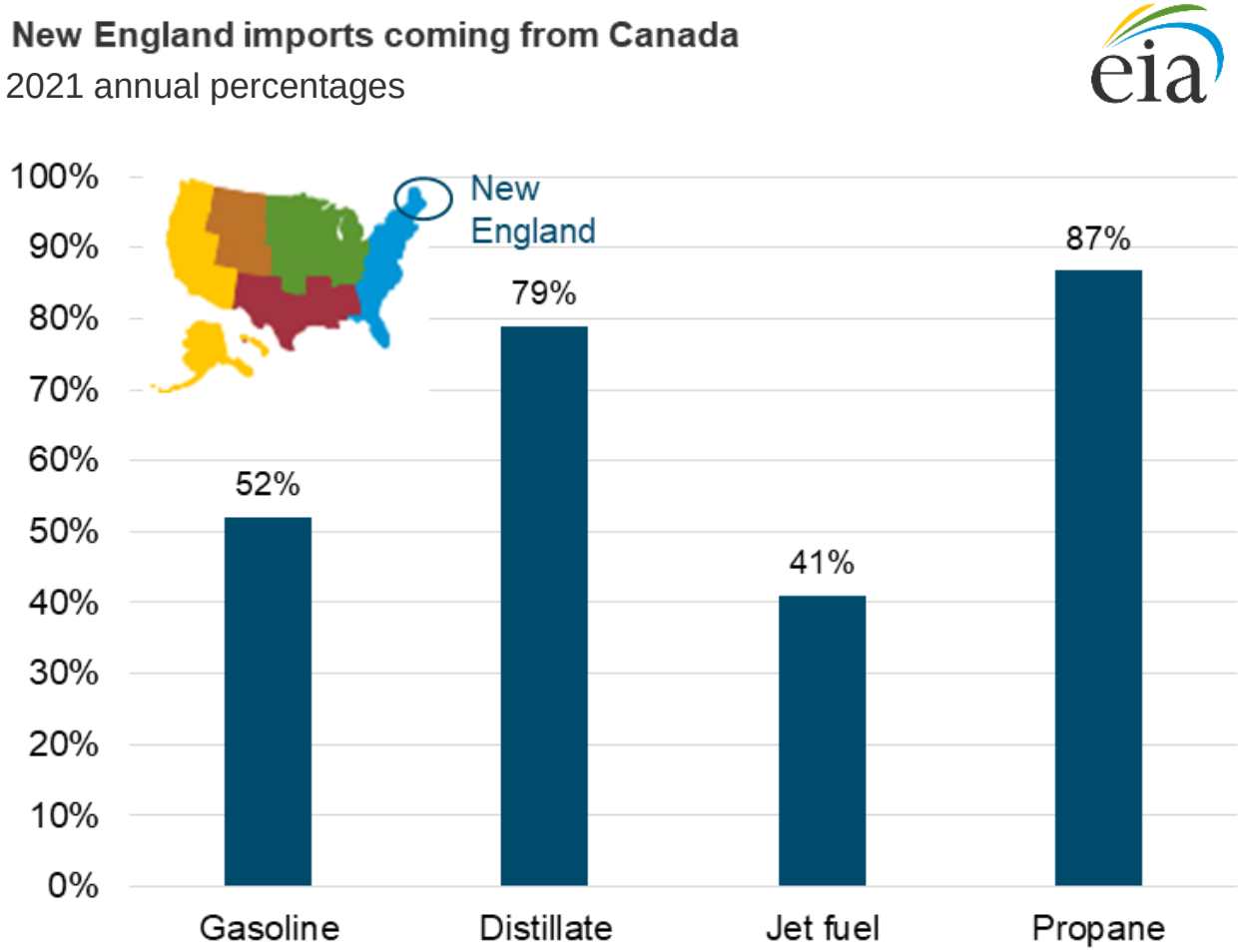
New England sales of gasoline and heating oil have been decreasing



Source: U.S. EIA, *Prime Supplier Report* May 2022

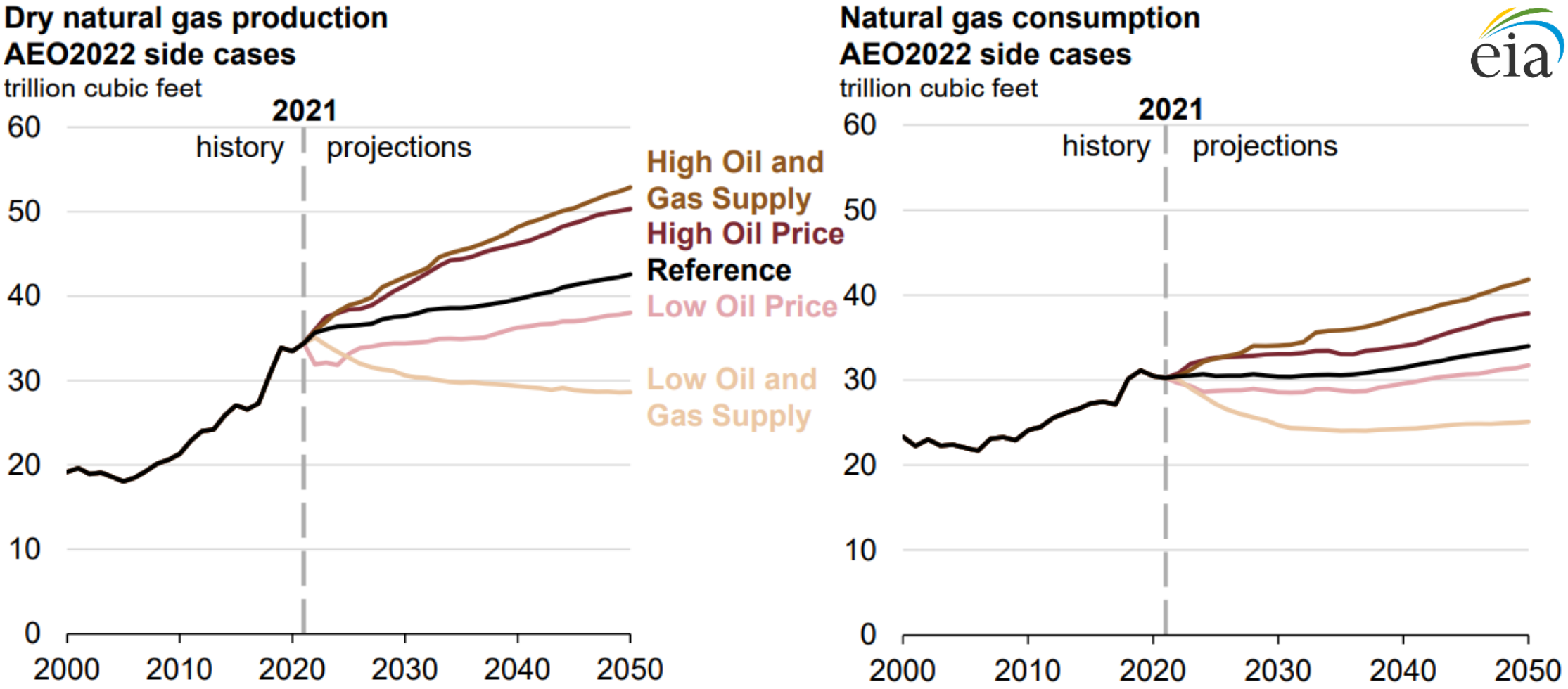
Most East Coast product consumption is from domestic supplies





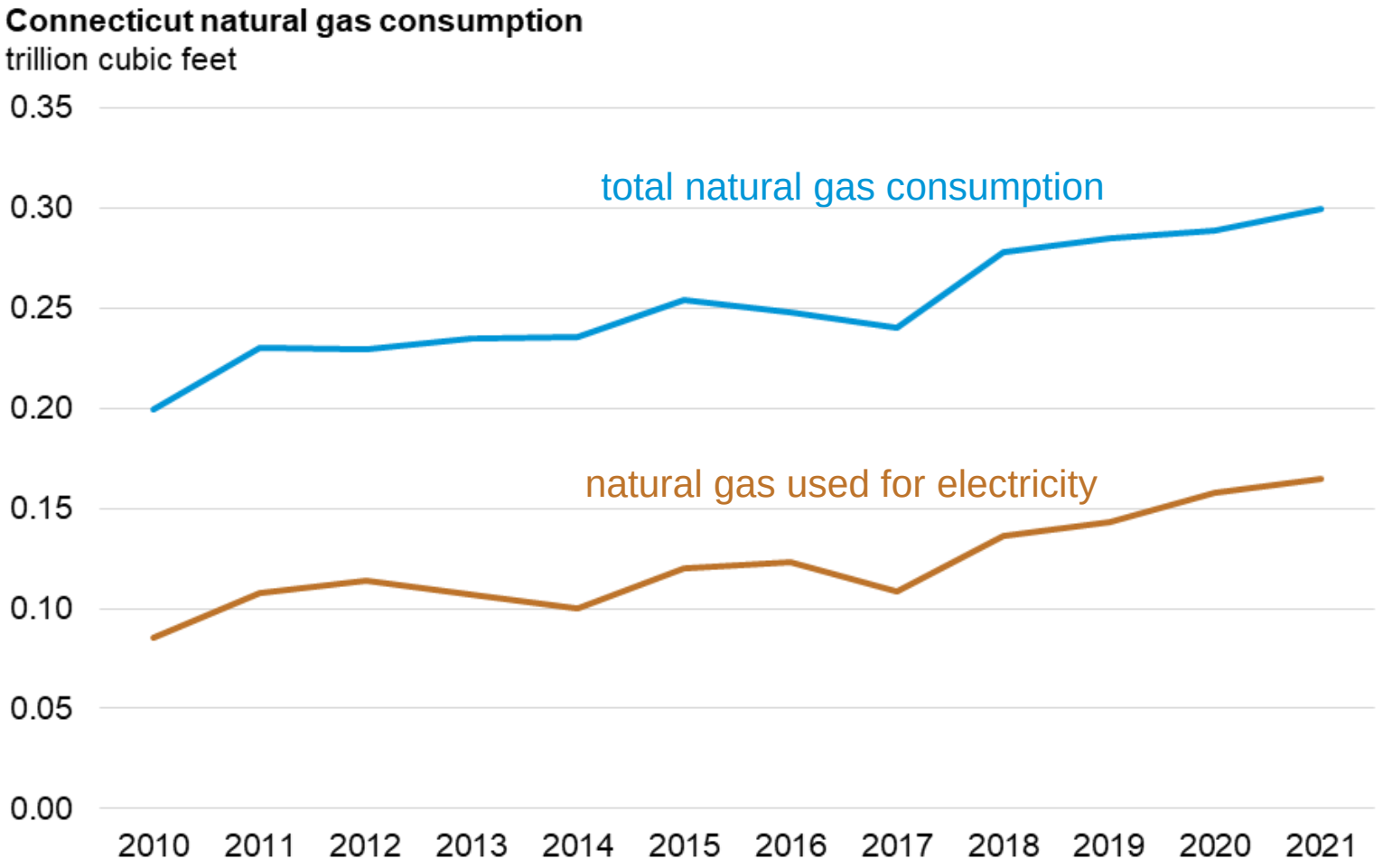
Source: U.S. EIA, *Petroleum Supply Monthly, Monthly Imports Report*

U.S. natural gas production and consumption (2000-2050)



Source: *U.S. EIA, Annual Energy Outlook 2022*

About 80% of Connecticut's increase in natural gas consumption since 2010 has been for electric power

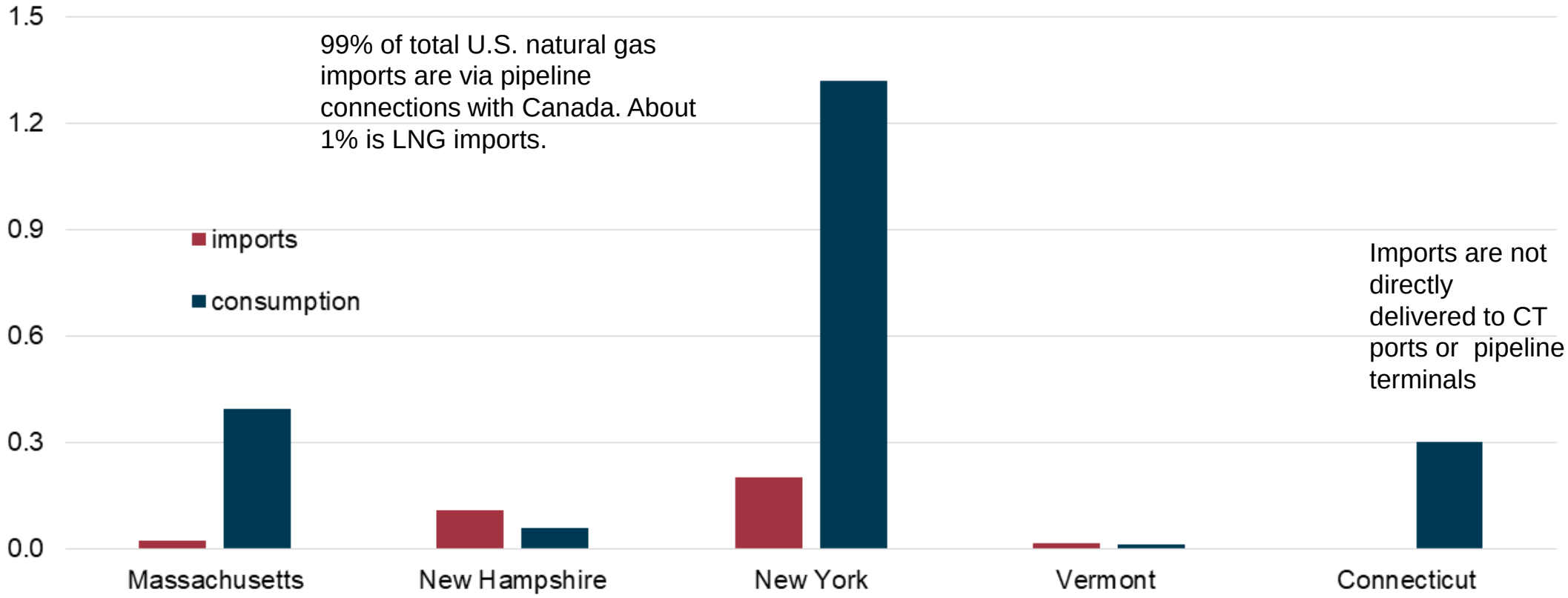


Source: U.S. EIA, State Energy Profile; *Natural Gas Annual*

- Natural gas is the source of 55% of electricity generation in Connecticut, according to 2021 EIA data
- 35% of households in the state use natural gas for home heating. Heating oil is used by 43% of households
- Next biggest natural gas uses are commercial, residential, and industrial (in that order)

U.S. natural gas imports come from Canada via pipeline

Natural gas imports and consumption in select states (2021)
trillion cubic feet



Source: U.S. EIA, *Natural Gas Annual*

For further information

Weekly Petroleum Status Report | www.eia.gov/petroleum/supply/weekly

This Week in Petroleum | https://www.eia.gov/petroleum/weekly/

Petroleum Supply Monthly | www.eia.gov/petroleum/supply/monthly

Monthly Energy Report | https://www.eia.gov/totalenergy/data/monthly/

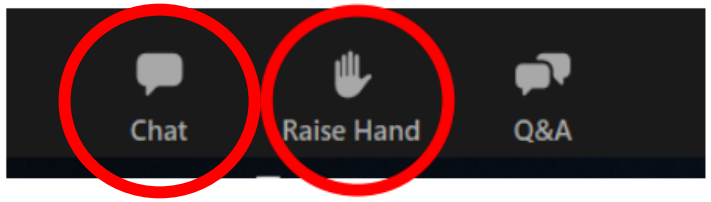
Short-Term Energy Outlook | www.eia.gov/steo

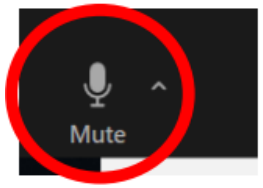
Annual Energy Outlook | www.eia.gov/aeo

International Energy Outlook | www.eia.gov/ieo

International Energy Statistics | www.eia.gov/beta/international

Questions and Comments





Lower left of the screen

At the conclusion of each panel DEEP will hold a brief question and answer period.

If you have a question for a presenter, please drop it into the chat to Jeff Howard. DEEP will pose as many questions as time allows to the speakers. Clarifying questions will be prioritized. Leading questions will not be accepted.

If you would like to make a comment during the public comment periods:

- Please use the “Raise Hand” feature if you would like to speak
- After any interested elected officials have provided their comments, you will be invited to provide your comment in the order the hands were raised
- Please unmute yourself, state your name and affiliation
- Given time limitations, please limit your comment to 2 minutes.
- After your comments, please remember to click the “Mute” button

General Public Comment

BUREAU OF ENERGY AND
TECHNOLOGY POLICY

Overview of Alternative Fuels

James Troderman & Mindi Farber-DeAnda – US Energy Information Administration (EIA)

(speaker order may vary)

BUREAU OF ENERGY AND TECHNOLOGY POLICY

US Energy Information Administration (EIA)

Recent Trends and EIA's Outlook on Alternative Fuels in the United States

For:

Connecticut Comprehensive Energy Strategy Session

November 4, 2022

By:

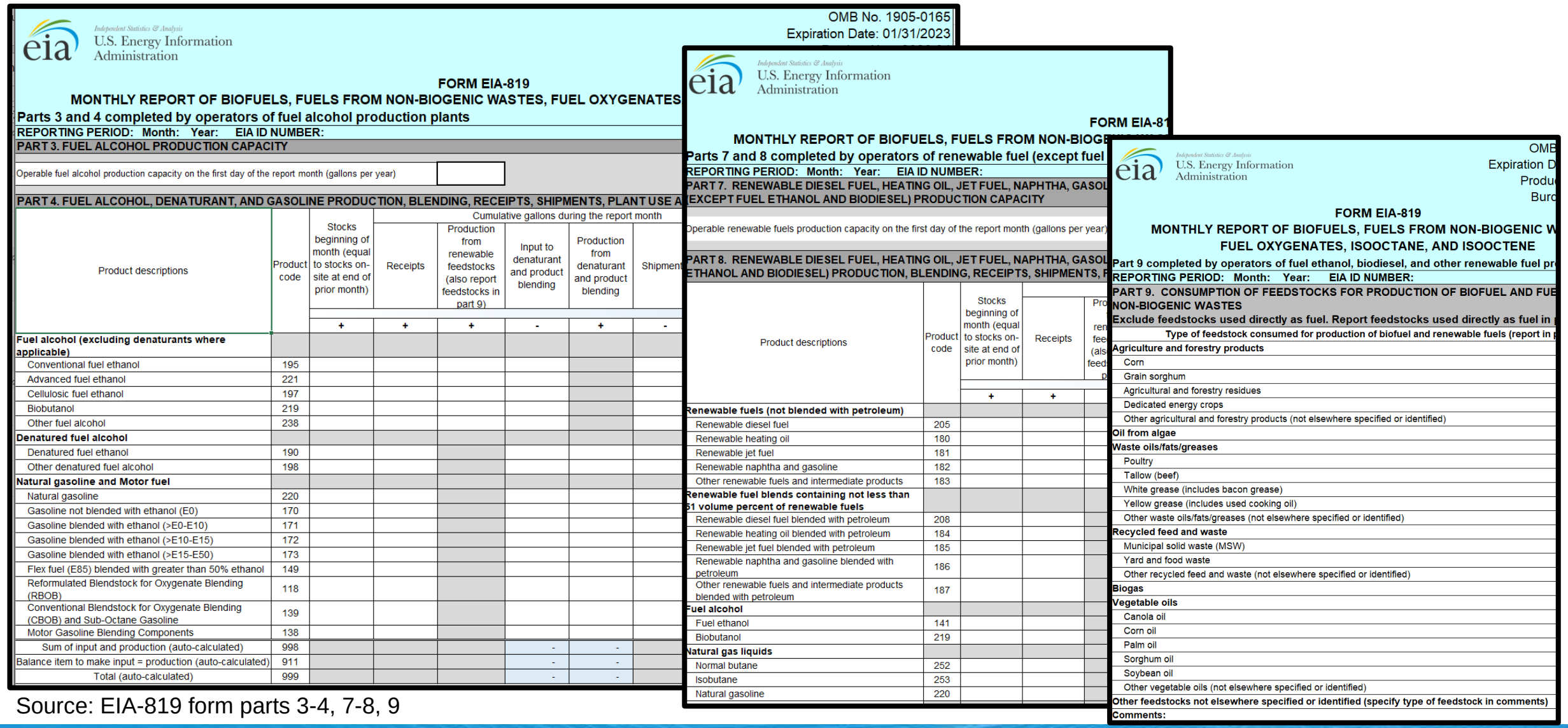
Jimmy Troderman and Mindi Farber-DeAnda

U.S. Energy Information Administration

Agenda

- Biofuels
  - Production capacities
  - Monthly data
  - Short-Term Energy Outlook (STEO)
  - Annual Energy Outlook (AEO)
  - International Energy Outlook (IEO)
- Renewable natural gas
- Articles and information of interest

New EIA data collection of biofuel production, feedstocks, capacity



Independent Statistics & Analysis
U.S. Energy Information Administration

OMB No. 1905-0165
Expiration Date: 01/31/2023

FORM EIA-819
MONTHLY REPORT OF BIOFUELS, FUELS FROM NON-BIOGENIC WASTES, FUEL OXYGENATES
Parts 3 and 4 completed by operators of fuel alcohol production plants
REPORTING PERIOD: Month: Year: EIA ID NUMBER:

PART 3. FUEL ALCOHOL PRODUCTION CAPACITY

Operable fuel alcohol production capacity on the first day of the report month (gallons per year)

PART 4. FUEL ALCOHOL, DENATURANT, AND GASOLINE PRODUCTION, BLENDING, RECEIPTS, SHIPMENTS, PLANT USE A

Cumulative gallons during the report month

Product descriptions	Product code	Stocks beginning of month (equal to stocks on-site at end of prior month)	Receipts	Production from renewable feedstocks (also report feedstocks in part 9)	Input to denaturant and product blending	Production from denaturant and product blending	Shipment
		+	+	+	-	+	-
Fuel alcohol (excluding denaturants where applicable)							
Conventional fuel ethanol	195						
Advanced fuel ethanol	221						
Cellulosic fuel ethanol	197						
Biobutanol	219						
Other fuel alcohol	238						
Denatured fuel alcohol							
Denatured fuel ethanol	190						
Other denatured fuel alcohol	198						
Natural gasoline and Motor fuel							
Natural gasoline	220						
Gasoline not blended with ethanol (E0)	170						
Gasoline blended with ethanol (>E0-E10)	171						
Gasoline blended with ethanol (>E10-E15)	172						
Gasoline blended with ethanol (>E15-E50)	173						
Flex fuel (E85) blended with greater than 50% ethanol	149						
Reformulated Blendstock for Oxygenate Blending (RBOB)	118						
Conventional Blendstock for Oxygenate Blending (CBOB) and Sub-Octane Gasoline	139						
Motor Gasoline Blending Components	138						
Sum of input and production (auto-calculated)	998				-	-	
Balance item to make input = production (auto-calculated)	911				-	-	
Total (auto-calculated)	999				-	-	

Independent Statistics & Analysis
U.S. Energy Information Administration

FORM EIA-81
MONTHLY REPORT OF BIOFUELS, FUELS FROM NON-BIOGE
Parts 7 and 8 completed by operators of renewable fuel (except fuel
REPORTING PERIOD: Month: Year: EIA ID NUMBER:

PART 7. RENEWABLE DIESEL FUEL, HEATING OIL, JET FUEL, NAPHTHA, GASOL (EXCEPT FUEL ETHANOL AND BIODIESEL) PRODUCTION CAPACITY

Operable renewable fuels production capacity on the first day of the report month (gallons per year)

PART 8. RENEWABLE DIESEL FUEL, HEATING OIL, JET FUEL, NAPHTHA, GASOL ETHANOL AND BIODIESEL) PRODUCTION, BLENDING, RECEIPTS, SHIPMENTS, F

Product descriptions	Product code	Stocks beginning of month (equal to stocks on-site at end of prior month)	Receipts	Pro ren fee (als feed p
		+	+	
Renewable fuels (not blended with petroleum)				
Renewable diesel fuel	205			
Renewable heating oil	180			
Renewable jet fuel	181			
Renewable naphtha and gasoline	182			
Other renewable fuels and intermediate products	183			
Renewable fuel blends containing not less than 51 volume percent of renewable fuels				
Renewable diesel fuel blended with petroleum	208			
Renewable heating oil blended with petroleum	184			
Renewable jet fuel blended with petroleum	185			
Renewable naphtha and gasoline blended with petroleum	186			
Other renewable fuels and intermediate products blended with petroleum	187			
Fuel alcohol				
Fuel ethanol	141			
Biobutanol	219			
Natural gas liquids				
Normal butane	252			
Isobutane	253			
Natural gasoline	220			

Independent Statistics & Analysis
U.S. Energy Information Administration

OMB
Expiration D
Produc
Buro

FORM EIA-819
MONTHLY REPORT OF BIOFUELS, FUELS FROM NON-BIOGENIC W
FUEL OXYGENATES, ISOOCTANE, AND ISOOCTENE
Part 9 completed by operators of fuel ethanol, biodiesel, and other renewable fuel pr
REPORTING PERIOD: Month: Year: EIA ID NUMBER:

PART 9. CONSUMPTION OF FEEDSTOCKS FOR PRODUCTION OF BIOFUEL AND FUE NON-BIOGENIC WASTES
Exclude feedstocks used directly as fuel. Report feedstocks used directly as fuel in

Type of feedstock consumed for production of biofuel and renewable fuels (report in
Agriculture and forestry products
Corn
Grain sorghum
Agricultural and forestry residues
Dedicated energy crops
Other agricultural and forestry products (not elsewhere specified or identified)
Oil from algae
Waste oils/fats/greases
Poultry
Tallow (beef)
White grease (includes bacon grease)
Yellow grease (includes used cooking oil)
Other waste oils/fats/greases (not elsewhere specified or identified)
Recycled feed and waste
Municipal solid waste (MSW)
Yard and food waste
Other recycled feed and waste (not elsewhere specified or identified)
Biogas
Vegetable oils
Canola oil
Corn oil
Palm oil
Sorghum oil
Soybean oil
Other vegetable oils (not elsewhere specified or identified)
Other feedstocks not elsewhere specified or identified (specify type of feedstock in comments)
Comments:

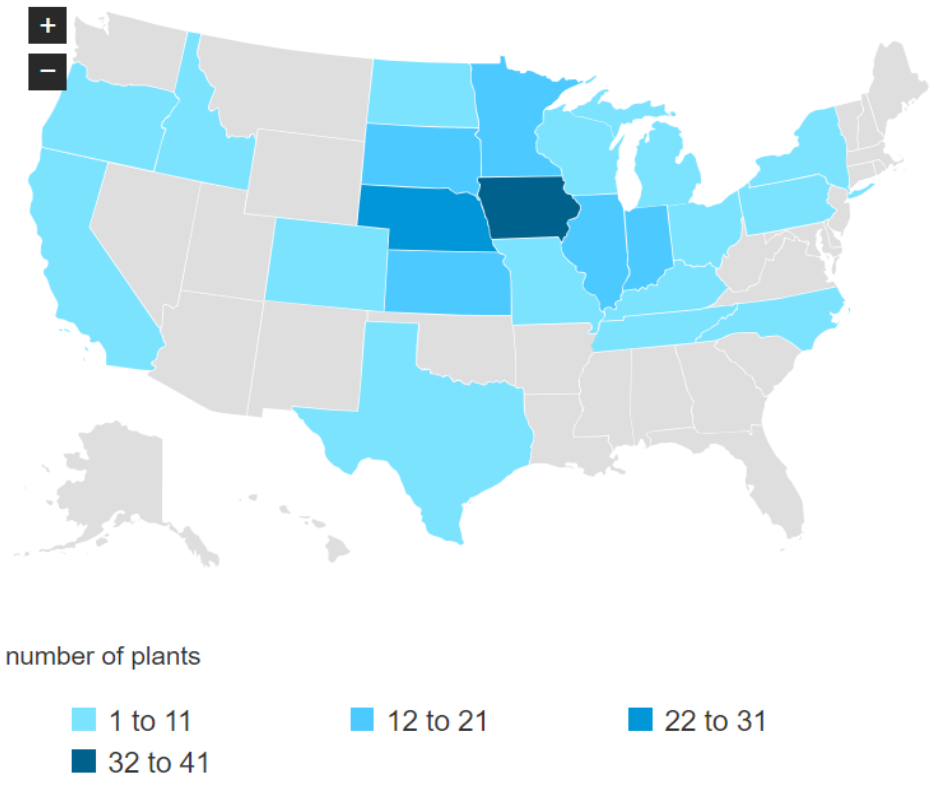
Source: EIA-819 form parts 3-4, 7-8, 9

Ethanol plants are concentrated in the Midwest

U.S. Fuel Ethanol Plant Production Capacity as of January 1, 2022

PAD District	Number of Plants	Nameplate Capacity (MMgal/year)	Nameplate Capacity (Mb/d)
PADD 1	3	247	16
PADD 2	177	16,325	1,065
PADD 3	3	380	25
PADD 4	4	200	13
PADD 5	5	228	15
U.S. Total	**192**	**17,380**	**1,134**

U.S. fuel ethanol plant count by state, 2022



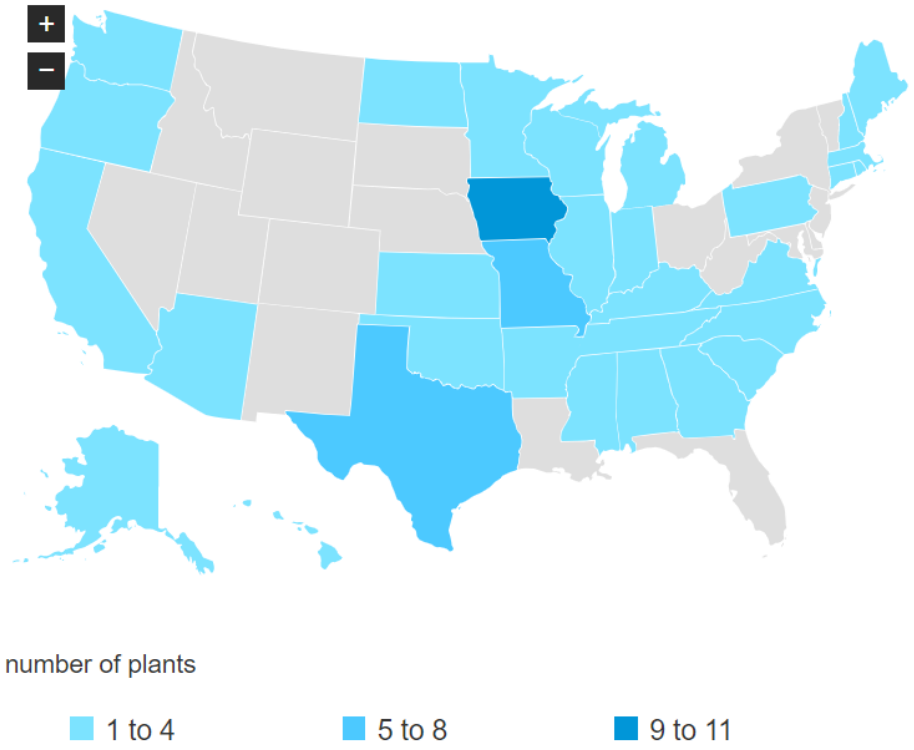
Source: U.S. EIA, *Monthly Report of Biofuels*

Biodiesel plants are concentrated in the Midwest, though there are 5 in New England

U.S. Biodiesel Plant Production Capacity as of January 1, 2022

PAD District	Number of Plants	Production Capacity (MMgal/year)	Production Capacity (Mb/d)
PADD 1	14	157	10
PADD 2	37	1,444	94
PADD 3	12	455	30
PADD 4	0	0	0
PADD 5	9	199	13
U.S. Total	**72**	**2,255**	**147**

U.S. biodiesel plant count by state, 2022



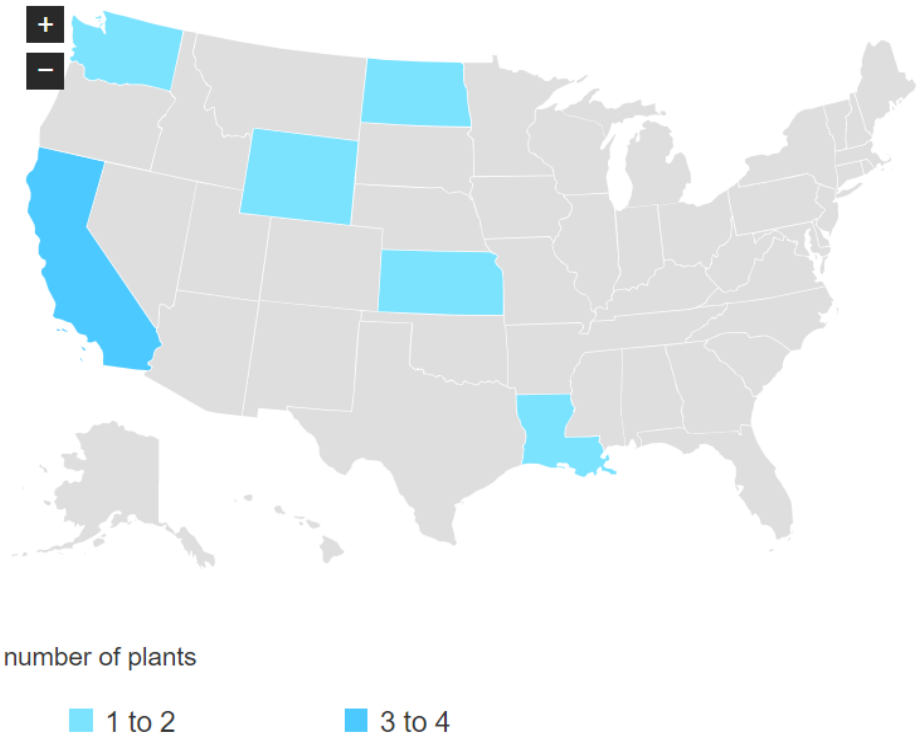
Source: U.S. EIA, *Monthly Report of Biofuels*

There are no renewable diesel or other biofuels plants on the East Coast

U.S. Renewable Diesel Fuel and Other Biofuels Plant Production Capacity as of January 1, 2022

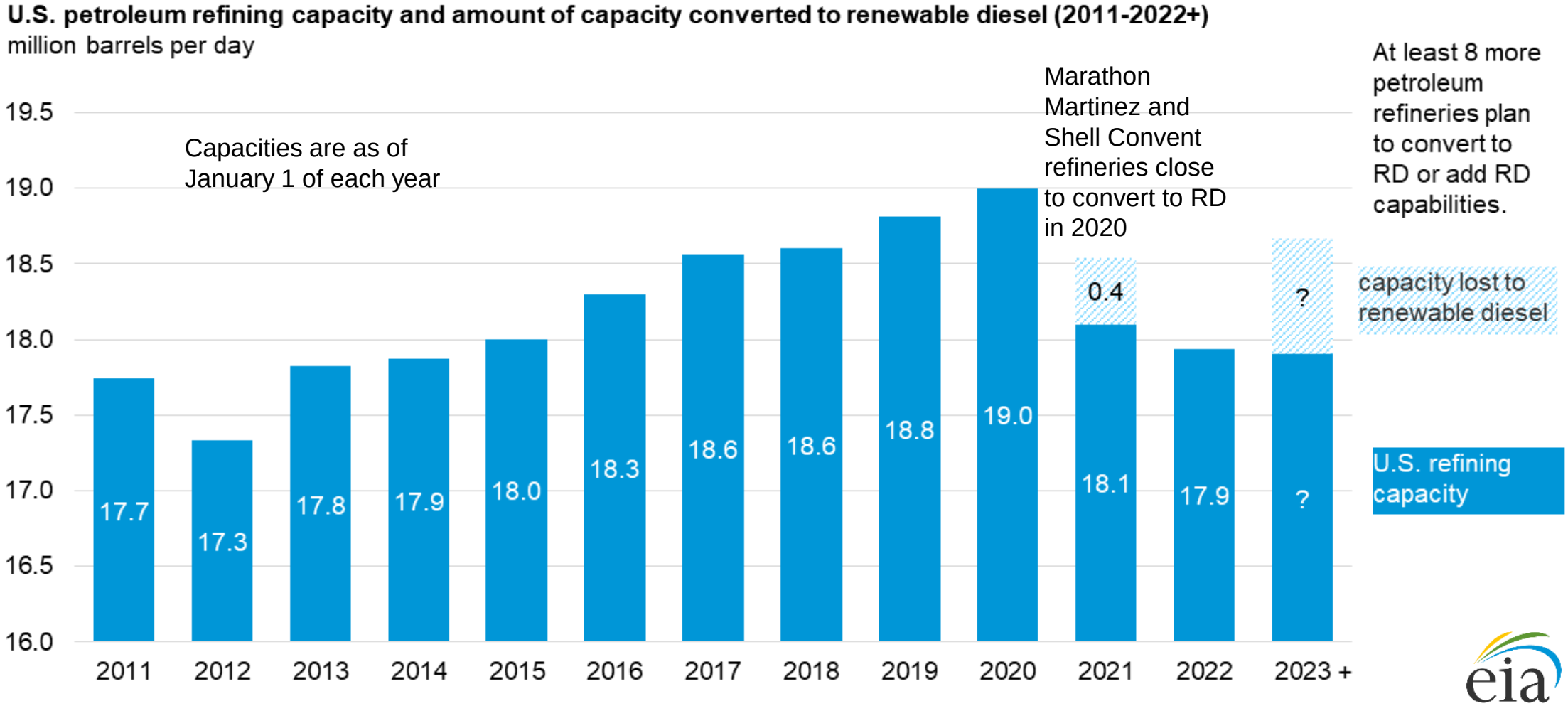
PAD District	Number of Plants	Production Capacity (MMgal/year)	Production Capacity (Mb/d)
PADD 1	0	0	0
PADD 2	2	195	13
PADD 3	2	1,082	71
PADD 4	2	209	14
PADD 5	5	265	17
U.S. Total	**11**	**1,750**	**114**

U.S. renewable diesel fuel and other biofuels plant count by state, 2022



Source: U.S. EIA, *Monthly Report of Biofuels*

U.S. refineries are shutting down or reconfiguring to co-produce renewable diesel



Source: U.S. EIA, *Refinery Capacity Report,* 2022

Renewable diesel capacity is growing

- Renewable diesel capacity set to approximately double from beginning of 2022 to end of 2023. Many more plants are slated for 2024 and 2025.
- And by 2030, there could be major plants in other eastern hemisphere countries such as Panama, Paraguay, and Canada.
- Growth potential is limited by feedstock availability. While soybean oil presents opportunities for scalability, EPA tries to balance volume requirements with interests to not disrupt food availability or wetlands.

Source: RFS Annual Rule, 2021

Government programs make biodiesel and renewable diesel profitable

- Required to achieve at least a 50 percent lifecycle GHG reductions relative to the petroleum fuels they displace.

- The cost of biodiesel and renewable diesel is significantly higher than petroleum-based diesel fuel and is expected to remain so over the next several years.

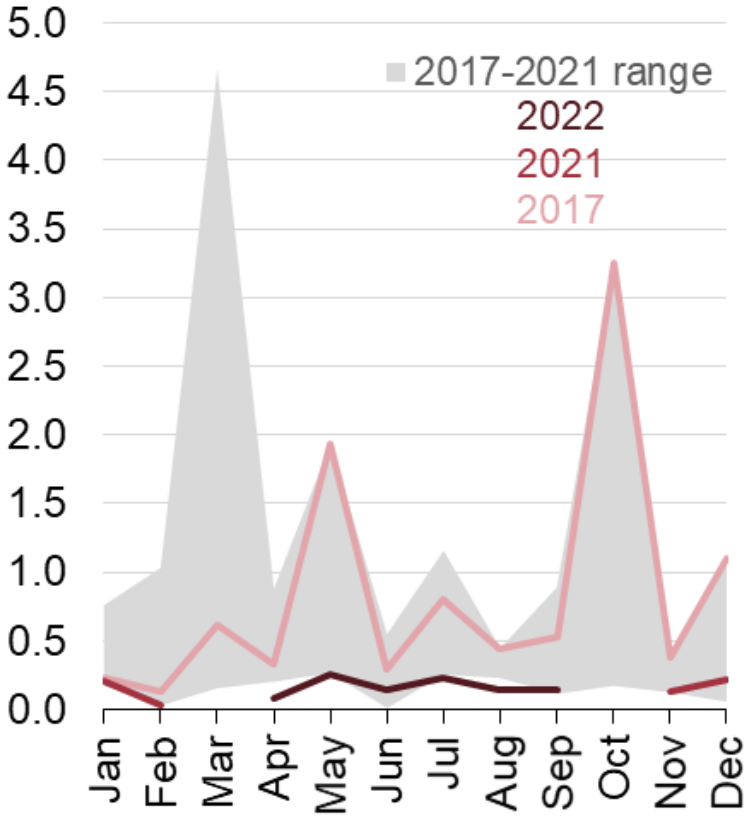
RD Price/gal ≈ California diesel price + $1.70 * RIN Credit
+ $1 BTC + LCFS Credit * Feedstock Adjustment
+ discount

RD is profitable as long as this price exceeds the cost of feedstocks + processing and transportation

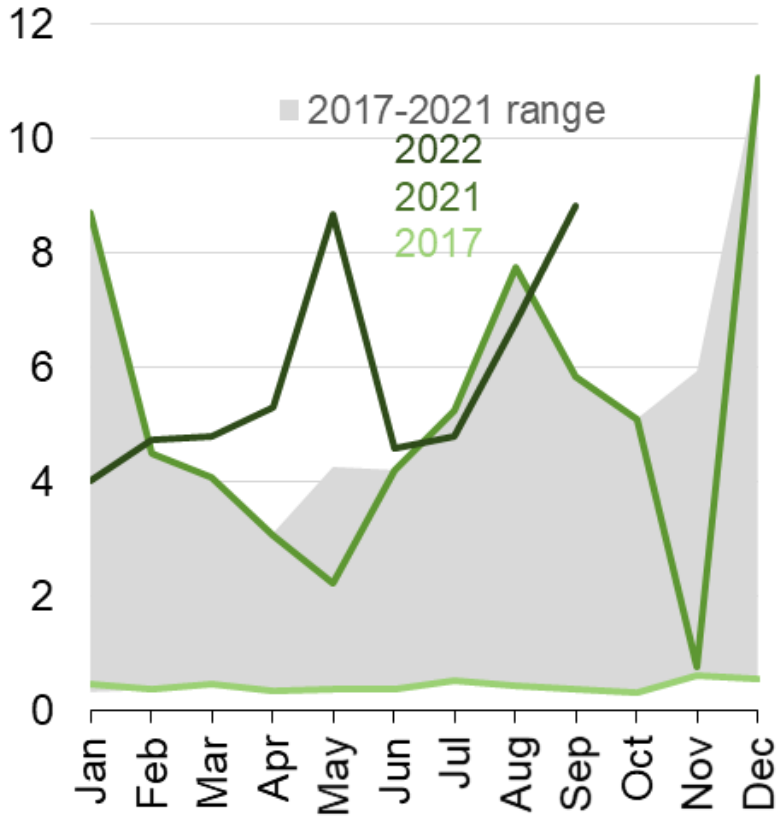
Source: RFS Annual Rule, 2021

EPA moderated transaction system (EMTS) volume data calculated from RINs

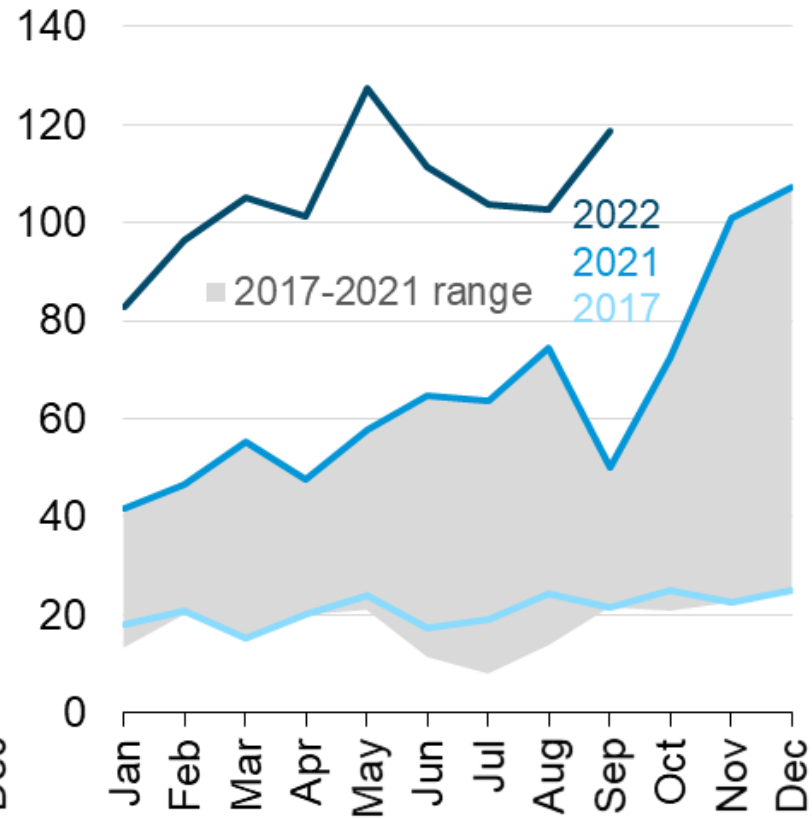
Cellulosic ethanol production
million gallons



D5 renewable diesel production
million gallons



D4 renewable diesel production
million gallons



Source: EPA EMTS 11/2/22.

U.S. biofuel data reporting in the Monthly Energy Review (MER)

Table 10.3 Fuel Ethanol Overview

	Feed-stock[a]	Losses and Co-products[b]	Dena-turant[c]	Production[d]			Trade[d] Net Imports[e]	Stocks[d,f]	Stock Change[d,g]	Consumption[d]			Consump-tion Minus Denaturant[h]
	TBtu	TBtu	Mbbl	Mbbl	MMgal	TBtu	Mbbl	Mbbl	Mbbl	Mbbl	MMgal	TBtu	*TBtu*
1981 Total	**13**	**6**	**40**	**1,978**	**83**								
1985 Total	**93**	**42**	**294**	**14,693**	**617**								
1990 Total	**111**	**49**	**356**	**17,802**	**748**								
1995 Total	**198**	**86**	**647**	**32,325**	**1,358**								
2000 Total	**233**	**99**	**773**	**38,627**	**1,622**								
2005 Total	**550**	**227**	**1,859**	**92,961**	**3,904**								
2006 Total	**683**	**280**	**2,326**	**116,294**	**4,884**								
2007 Total	**907**	**368**	**3,105**	**155,263**	**6,521**								
2008 Total	**1,286**	**518**	**4,433**	**221,637**	**9,309**								
2009 Total	**1,503**	**602**	**5,688**	**260,424**	**10,938**								
2010 Total	**1,823**	**726**	**6,506**	**316,617**	**13,298**								
2011 Total	**1,904**	**754**	**6,649**	**331,646**	**13,929**								
2012 Total	**1,801**	**709**	**6,264**	**314,714**	**13,218**								
2013 Total	**1,809**	**711**	**6,181**	**316,493**	**13,293**								
2014 Total	**1,947**	**764**	**6,476**	**340,781**	**14,313**								
2015 Total	**2,013**	**788**	**6,636**	**352,553**	**14,807**								
2016 Total	**2,092**	**818**	**6,920**	**366,981**	**15,413**								
2017 Total	**2,164**	**844**	**6,657**	**379,435**	**15,936**								
2018 Total	**2,187**	**852**	**5,819**	**383,127**	**16,091**								
2019 Total	**2,140**	**832**	**6,089**	**375,678**	**15,778**								
2020 January	190	74	549	33,346	1,401								
February	174	67	482	30,511	1,281								
March	167	65	482	29,409	1,235								
April	97	37	307	17,003	714								
May	120	47	383	21,157	889								
June	147	57	473	25,959	1,090								
July	163	63	531	28,708	1,206								
August	161	63	513	28,420	1,194								
September	158	61	498	27,779	1,167								
October	168	65	546	29,614	1,244								
November	170	66	563	29,915	1,256								
December	171	66	564	30,108	1,265								
Total	**1,886**	**732**	**5,892**	**331,928**	**13,941**								
2021 January	164	63	491	28,847	1,212								
February	130	50	391	22,928	963								
March	167	65	508	29,338	1,232								
April	160	62	483	28,218	1,185								
May	177	69	533	31,223	1,311								
June	174	67	529	30,682	1,289								
July	178	69	542	31,436	1,320								
August	165	64	470	29,076	1,221								
September	160	62	466	28,087	1,180								
October	183	71	522	32,165	1,351								
November	184	71	549	32,384	1,360								
December	188	73	613	33,118	1,391								
Total	**2,030**	**786**	**6,095**	**357,502**	**15,015**								
2022 January	183	71	600	32,207	1,353								
February	161	62	488	28,321	1,189								
2-Month Total	**343**	**133**	**1,088**	**60,528**	**2,542**								
2021 2-Month Total	**294**	**114**	**882**	**51,775**	**2,175**								

Table 10.4a Biodiesel Overview

	Feed-stock[b]	Losses and Co-products[c]	Production[a]			Trade[a] Imports	Exports	Net Imports					
	TBtu	TBtu	Mbbl	MMgal	TBtu	Mbbl	Mbbl	Mbbl					
2001 Total	**1**	**(s)**	**204**	**9**	**1**	**81**	**41**	**40**					
2005 Total	**12**	**(s)**	**2,162**	**91**	**12**	**214**	**213**	**1**					
2006 Total	**32**	**(s)**	**5,963**	**250**	**32**	**1,105**	**856**	**250**					
2007 Total	**63**	**1**	**11,662**	**490**	**62**	**3,455**	**6,696**	**-3,241**					
2008 Total	**88**	**1**	**16,145**	**678**	**87**	**7,755**	**16,673**	**-8,918**					
2009 Total	**67**	**1**	**12,281**	**516**	**66**	**1,906**	**6,546**	**-4,640**					
2010 Total	**44**	**1**	**8,177**	**343**	**44**	**564**	**2,588**	**-2,024**					
2011 Total	**125**	**2**	**23,035**	**967**	**123**	**890**	**1,799**	**-908**					
2012 Total	**128**	**2**	**23,588**	**991**	**126**	**853**	**3,056**	**-2,203**					
2013 Total	**176**	**2**	**32,368**	**1,359**	**173**	**8,152**	**4,675**	**3,477**					
2014 Total	**165**	**2**	**30,452**	**1,279**	**163**	**4,578**	**1,974**	**2,604**					
2015 Total	**163**	**2**	**30,080**	**1,263**	**161**	**8,399**	**2,091**	**6,308**					
2016 Total	**203**	**3**	**37,327**	**1,568**	**200**	**16,879**	**2,098**	**14,781**					
2017 Total	**206**	**3**	**37,993**	**1,596**	**204**	**9,374**	**2,228**	**7,146**					
2018 Total	**240**	**3**	**44,222**	**1,857**	**237**	**3,969**	**2,470**	**1,499**					
2019 Total	**223**	**3**	**41,060**	**1,725**	**220**	**4,078**	**2,730**	**1,348**					
2020 January	17	(s)	3,196	134	17	336	31	305					
February	17	(s)	3,139	132	17	302	89	213					
March	20	(s)	3,594	151	19	333	228	105					
April	19	(s)	3,422	144	18	611	526	85					
May	20	(s)	3,630	152	19	475	496	-21					
June	20	(s)	3,590	151	19	446	523	-77					
July	21	(s)	3,849	162	21	346	376	-30					
August	21	(s)	3,872	163	21	234	512	-278					
September	21	(s)	3,790	159	20	360	426	-66					
October	20	(s)	3,743	157	20	420	113	307					
November	20	(s)	3,621	152	19	448	73	375					
December	20	(s)	3,761	158	20	373	64	309					
Total	**235**	**3**	**43,207**	**1,815**	**232**	**4,684**	**3,458**	**1,226**					
2021 January	17	(s)	3,115	131	17	228	222	6					
February	13	(s)	2,406	101	13	263	122	141					
March	18	(s)	3,371	142	18	361	267	94					
April	17	(s)	3,210	135	17	500	494	6					
May	19	(s)	3,537	149	19	316	585	-269					
June	18	(s)	3,241	136	17	446	646	-200					
July	18	(s)	3,336	140	18	357	489	-132					
August	18	(s)	3,325	140	18	287	548	-261					
September	16	(s)	2,990	126	16	418	374	44					
October	19	(s)	3,473	146	19	473	211	262					
November	18	(s)	3,360	141	18	660	182	478					
December	20	(s)	3,654	153	20	523	204	319	4,184	443	3,530	148	19
Total	**212**	**3**	**39,019**	**1,639**	**209**	**4,832**	**4,342**	**490**	**4,184**	**r301**	**39,208**	**1,647**	**210**
2022 January	16	(s)	2,858	120	15	388	1,124	-736	4,337	152	1,970	83	11
February	15	(s)	2,710	114	15	121	111	10	4,395	58	2,662	112	14
2-Month Total	**30**	**(s)**	**5,569**	**234**	**30**	**509**	**1,236**	**-727**	**4,395**	**210**	**4,632**	**195**	**25**
2021 2-Month Total	**30**	**(s)**	**5,521**	**232**	**30**	**491**	**343**	**148**	**4,253**	**369**	**5,299**	**223**	**28**
2020 2-Month Total	**34**	**(s)**	**6,335**	**266**	**34**	**638**	**121**	**517**	**4,220**	**313**	**6,539**	**275**	**35**

Table 10.4b Renewable Diesel Fuel Overview

	Feed-stock[c]	Losses and Co-products[d]	Production[a,e]			Trade[a,b] Imports	Stocks[a,f]	Stock Change[a,g]	Consumption[a,h]		
	TBtu	TBtu	Mbbl	MMgal	TBtu	Mbbl	Mbbl	Mbbl	Mbbl	MMgal	TBtu
2011 Total	**NA**	**NA**	**1,477**	**62**	**8**	**–**	**7**	**7**	**1,470**	**62**	**8**
2012 Total	**NA**	**NA**	**1,248**	**52**	**7**	**605**	**94**	**87**	**1,766**	**74**	**10**
2013 Total	**NA**	**NA**	**2,697**	**113**	**15**	**4,921**	**691**	**597**	**7,021**	**295**	**39**
2014 Total	**NA**	**NA**	**3,789**	**159**	**21**	**2,873**	**350**	**-341**	**7,003**	**294**	**38**
2015 Total	**NA**	**NA**	**4,211**	**177**	**23**	**4,874**	**634**	**284**	**8,801**	**370**	**48**
2016 Total	**NA**	**NA**	**5,750**	**241**	**32**	**5,304**	**1,315**	**681**	**10,373**	**436**	**57**
2017 Total	**NA**	**NA**	**6,151**	**258**	**34**	**4,509**	**753**	**-562**	**11,222**	**471**	**62**
2018 Total	**NA**	**NA**	**7,273**	**305**	**40**	**4,124**	**1,727**	**974**	**10,423**	**438**	**57**
2019 Total	**NA**	**NA**	**11,715**	**492**	**64**	**6,143**	**1,491**	**-236**	**18,094**	**760**	**99**
2020 January	NA	NA	997	42	5	605	1,714	223	1,379	58	8
February	NA	NA	888	37	5	411	1,388	-326	1,625	68	9
March	NA	NA	1,077	45	6	452	1,431	43	1,486	62	8
April	NA	NA	920	39	5	664	1,557	126	1,458	61	8
May	NA	NA	1,105	46	6	505	1,741	184	1,426	60	8
June	NA	NA	1,267	53	7	615	1,536	-205	2,087	88	11
July	NA	NA	1,112	47	6	318	1,508	-28	1,458	61	8
August	NA	NA	1,046	44	6	435	1,379	-129	1,610	68	9
September	NA	NA	1,146	48	6	517	1,356	-23	1,686	71	9
October	NA	NA	601	25	3	617	1,426	70	1,148	48	6
November	NA	NA	1,168	49	6	645	1,387	-39	1,852	78	10
December	NA	NA	1,376	58	8	874	1,287	-100	2,350	99	13
Total	**NA**	**NA**	**12,702**	**533**	**70**	**6,658**	**1,287**	**-204**	**19,564**	**822**	**107**
2021 January	NA	NA	e1,335	e56	e7	771	1,719	432	1,674	70	9
February	NA	NA	1,156	49	6	741	1,985	266	1,631	69	9
March	NA	NA	1,250	53	7	893	1,974	-11	2,154	90	12
April	NA	NA	1,205	51	7	1,013	1,942	-33	2,251	95	12
May	NA	NA	1,503	63	8	870	1,767	-175	2,548	107	14
June	NA	NA	1,315	55	7	1,092	1,935	168	2,239	94	12
July	NA	NA	1,706	72	9	549	2,300	365	1,890	79	10
August	NA	NA	1,679	71	9	597	2,063	-237	2,513	106	14
September	NA	NA	1,255	53	7	636	2,250	187	1,704	72	9
October	NA	NA	2,027	85	11	795	1,883	-367	3,190	134	18
November	NA	NA	2,255	95	12	890	2,107	223	2,921	123	16
December	NA	NA	2,720	114	15	493	2,353	246	2,967	125	16
Total	**NA**	**NA**	**19,407**	**815**	**107**	**9,340**	**2,353**	**1,066**	**27,681**	**1,163**	**152**
2022 January	NA	NA	2,632	111	14	632	2,710	357	2,907	122	16
February	NA	NA	2,300	97	13	359	2,748	38	2,620	110	14
2-Month Total	**NA**	**NA**	**4,932**	**207**	**27**	**991**	**2,748**	**395**	**5,528**	**232**	**30**
2021 2-Month Total	**NA**	**NA**	**2,491**	**105**	**14**	**1,512**	**1,985**	**698**	**3,305**	**139**	**18**
2020 2-Month Total	**NA**	**NA**	**1,885**	**79**	**10**	**1,016**	**1,388**	**-103**	**3,004**	**126**	**17**

Expanded biofuel data reporting in Petroleum Supply Monthly (PSM)

eia Independent Statistics & Analysis U.S. Energy Information Administration + Sources & Uses + Topics + Geography + Tools + Learn About Energy + News Search eia.gov

PETROLEUM & OTHER LIQUIDS

OVERVIEW DATA ANALYSIS & PROJECTIONS GLOSSARY › FAQS ›

‹ SEE ALL PETROLEUM REPORTS

Monthly Biofuels Capacity and Feedstocks Update

With Data for March 2022 | **Release Date:** May 31, 2022 | **Next Release Date:** June 30, 2022

Previous Issues: Select Month

Data Tables

1	Biofuels operable production capacity	PDF	XLS
2	Feedstocks consumed for production of biofuels	PDF	XLS

Related Links:
U.S. Biodiesel Plant Production Capacity - The report contains data for U.S. biodiesel plants.

Biofuels Operable Production Capacity

(Million Gallons per Year)

Area: U.S. **Period:** Monthly

Download Series History | Definitions, Sources & Notes

Show Data By: Product / Area	Graph / Clear	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	View History
Fuel Ethanol		17,393	17,428	17,385	17,399	17,423	17,323	2021-2022
Biodiesel		2,461	2,389	2,244	2,245	2,232	2,231	2011-2022
Renewable Diesel and Other Biofuels		1,014	1,017	1,106	1,468	1,468	1,468	2021-2022

Click on the source key icon to learn how to download series into Excel, or to embed a chart or map on your website.

- = No Data Reported; -- = Not Applicable; **NA** = Not Available; **W** = Withheld to avoid disclosure of individual company data.

Notes: Other Biofuels includes renewable heating oil, renewable jet fuel, renewable naphtha, renewable gasoline, and other biofuels and biointermediates. See Definitions, Sources, and Notes link above for more information on this table.

Release Date: 5/31/2022
Next Release Date: 6/30/2022

PETROLEUM & OTHER LIQUIDS

OVERVIEW DATA ANALYSIS & PROJECTIONS GLOSSARY › FAQS ›

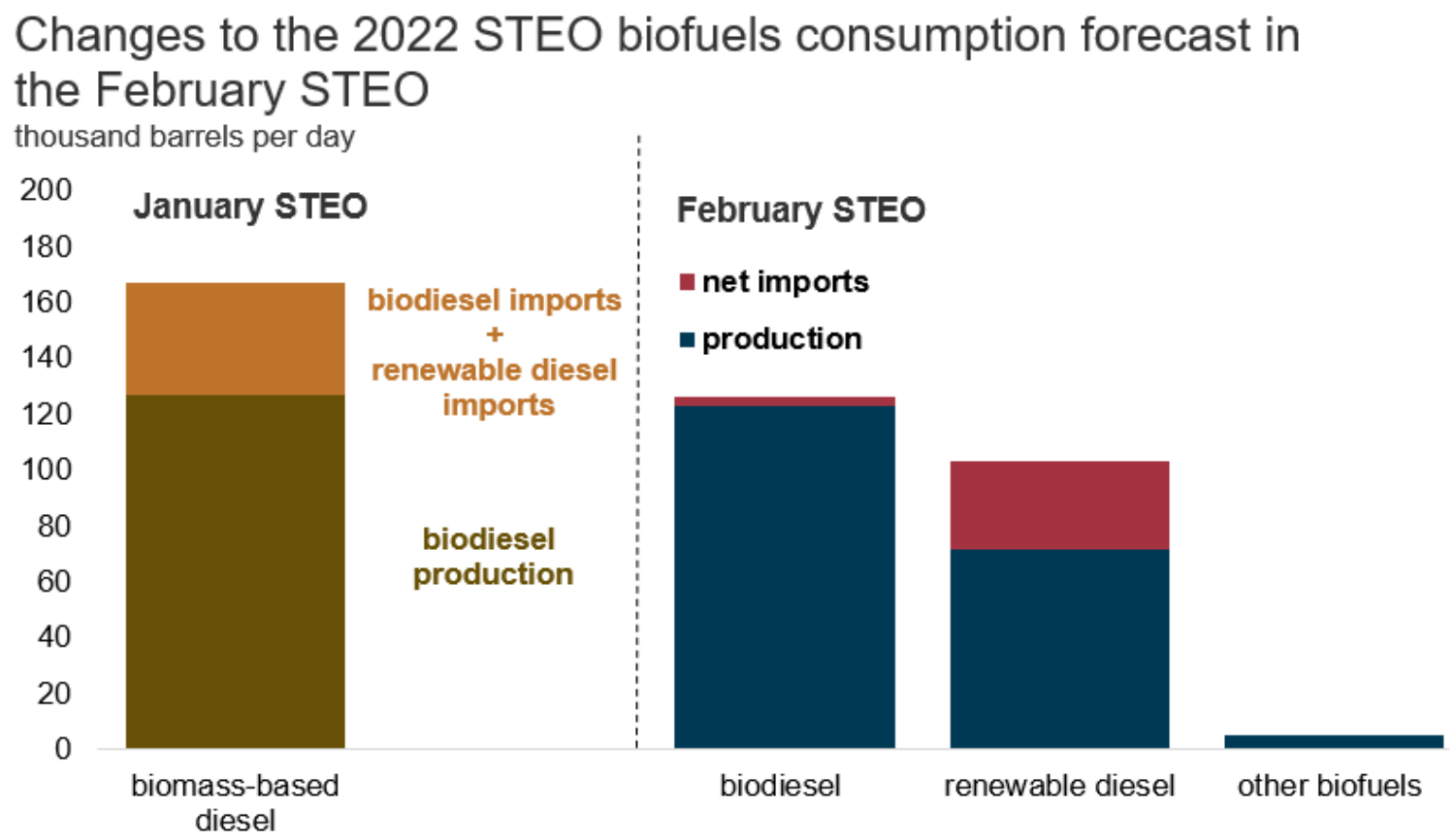
Supply and Disposition

Area: U.S. **Latest Periods:** Mar 2022 (Current) **Unit:** Thousand Barrels per Day Click a table value for series history

Download Series History | Definitions, Sources & Notes

Show Data By: Product / Area	Supply: Field Production	Supply: Biofuels Plant Net Production	Supply: Refinery & Blender Net Production	Supply: Imports	Supply: Net Receipts	Supply: Adjust-ments	Disposition: Stock Change	Disposition: Refinery & Blender Net Inputs	Disposition: Exports	Disposition: Products Supplied	Ending Stocks
Crude Oil & Petroleum Products	17,564	1,197	19,184	8,461		1,041	-795	18,216	9,513	20,512	
Crude Oil	11,655	--	--	6,416		827	-244	15,823	3,319	0	
Hydrocarbon Gas Liquids	5,909	-22	632	199		--	55	580	2,529	3,553	
Natural Gas Liquids	5,909	-22	369	181		--	65	580	2,529	3,263	
Ethane	2,507	--	5	-		--	20		528	1,963	
Propane	1,831	--	284	134		--	-29		1,464	813	
Normal Butane	505		97	42		--	50	163	374	57	
Isobutane	453		-17	5		--	6	214	5	216	
Natural Gasoline	613	-22		0		--	17	203	158	213	
Refinery Olefins	--	--	262	18		--	-10	--	--	291	
Ethylene	--	--	1	-		--	0	--	--	1	
Propylene	--	--	274	17		--	-4	--	--	295	
Butylene	--	--	-14	1		--	-7	--	--	-6	
Isobutylene	--	--	1	-		--	1	--	--	1	
Other Liquids	--	1,214	--	1,074		128	-253	1,813	585	271	
Hydrogen/Biofuels/Other Hydrocarbons	--	1,214	--	39		179	7	1,165	109	150	
Hydrogen	--	--	--			214	--	214		0	--
Oxygenates (excl. Fuel Ethanol)	--	--	--	--		--	--	--	--	-	
Biofuels (incl. Fuel Ethanol)	--	1,214	--	38		-35	7	951	109	150	
Fuel Ethanol	--	1,019	--	-		-35	4	883	96	0	
Biofuels (excl. Fuel Ethanol)	--	195	--	38		-	3	68	13	150	
Biodiesel	--	102	--	21		-	4	47	13	59	
Renewable Diesel Fuel	--	84	--	18		-	-1	11	NA	92	
Other Biofuels	--	9	--	-		-	0	10	NA	-1	
Other Hydrocarbons	--	--	--	0		0	0	1		0	

Expanded biofuels forecasts in the Short-Term Energy Outlook (STEO)



Source: U.S. Energy Information Administration, *Short-Term Energy Outlook* (STEO)
Note: Data are annual averages for 2022. The combined totals for the data on the right are greater than the data on the left because previous STEOs did not account for renewable diesel or other biofuel production in the calculation of biomass-based diesel consumption.

Source: U.S. EIA, *Short-Term Energy Outlook*

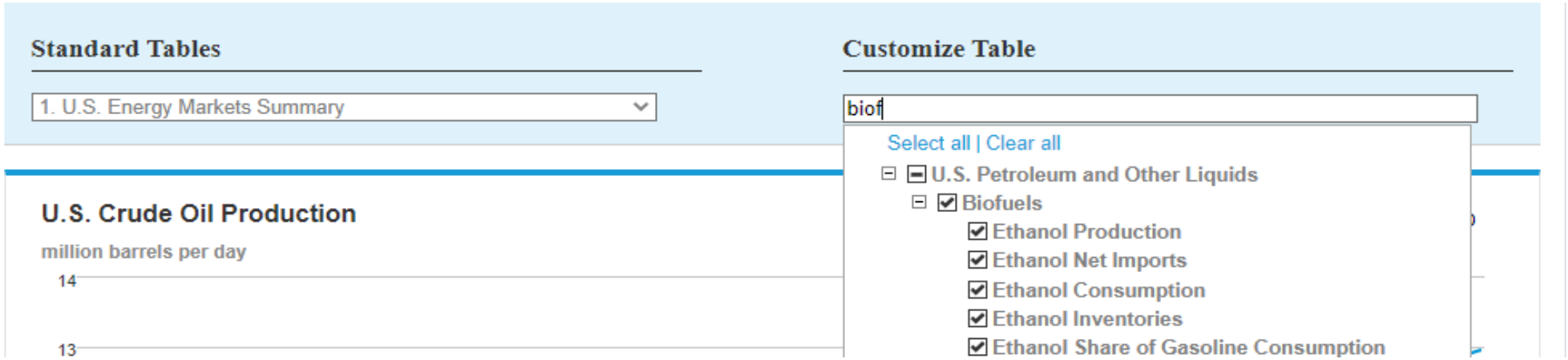
Modeling biofuels in STEO

- Historical data is taken from PSM and supplemented by WPSR*
  - PSM data is broken down into ethanol, biodiesel, renewable diesel, and other biofuels
  - WPSR has ethanol production only. WPSR numbers are used to extrapolate from most recent PSM to fill in for months with no PSM data
- Model equations incorporate a lag variable, seasonal trend variables, and motor gasoline consumption (for ethanol consumption)
- Analyst judgement based on Renewable Fuel Standard (RFS), feedstock prices and availability, and expectations for production capacity are used to add factor the forecasts

* WPSR = Weekly Petroleum Status Report

Expanded biofuels data in the STEO data browser

Type “biofuels” into the search bar to pull up all biofuels series/forecasts



Then choose which forecasts to graph

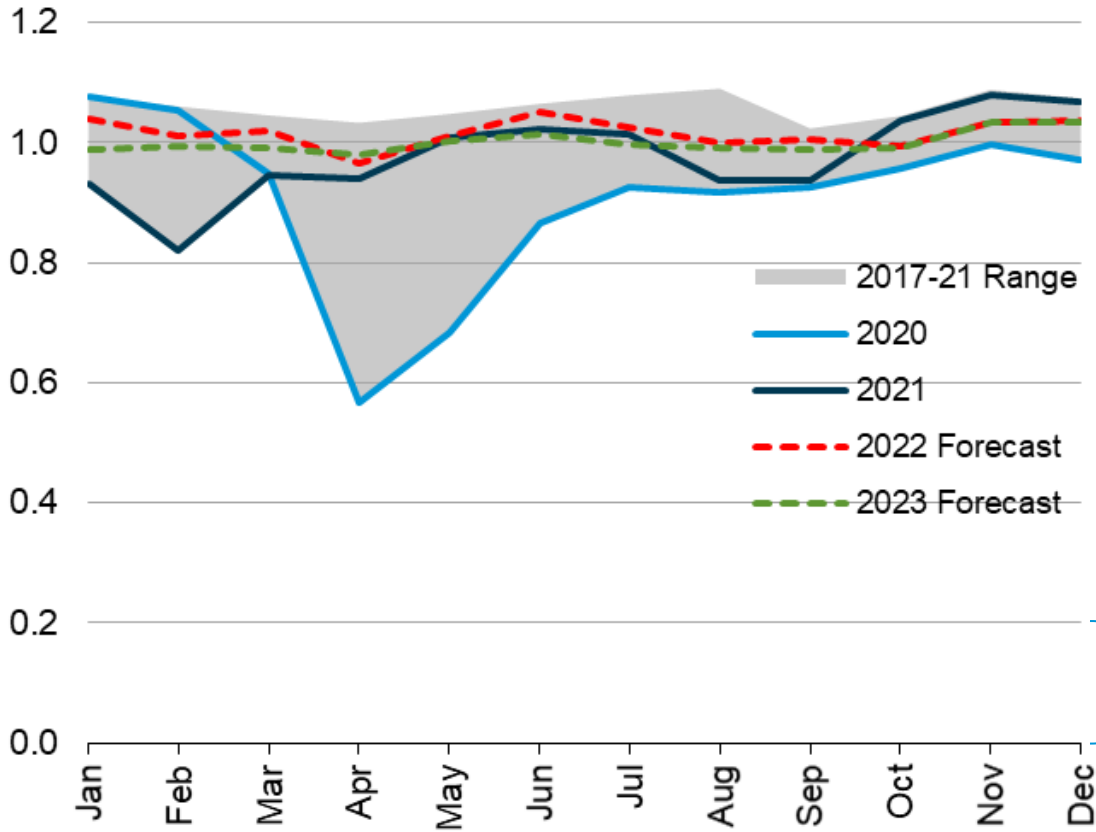
	20	2021	2022	2023
Other Biofuels Net Imports (million barrels per day)	00	0.000	0.000	0.000
Other Biofuels Production (million barrels per day)	02	0.005	0.012	0.024
Other Biofuels Consumption (million barrels per day)	02	0.005	0.012	0.024
Renwable Diesel Net Imports (million barrels per day)	18	0.026	0.028	0.037
Renewable Diesel Production (million barrels per day)	35	0.053	0.093	0.116
Renewable Diesel Consumption (million barrels per day)	53	0.076	0.120	0.153
Biodiesel Net Imports (million barrels per day)	03	0.001	0.008	0.008
Biodiesel Production (million barrels per day)	18	0.107	0.100	0.086

Easiest way to navigate to this web page is to google “STEO data browser”

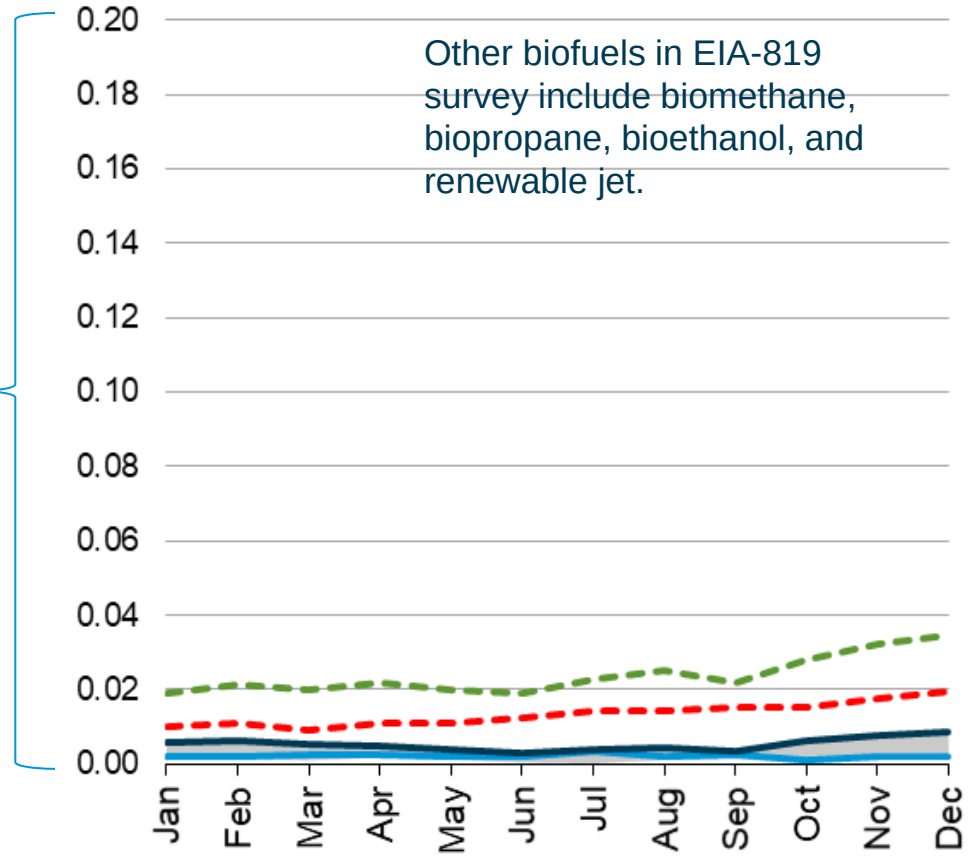
Source: U.S. EIA, *Short-Term Energy Outlook*

MER/PSM and STEO expanded to include other biofuels in addition to ethanol in 2021-22

U.S. ethanol production
million barrels per day



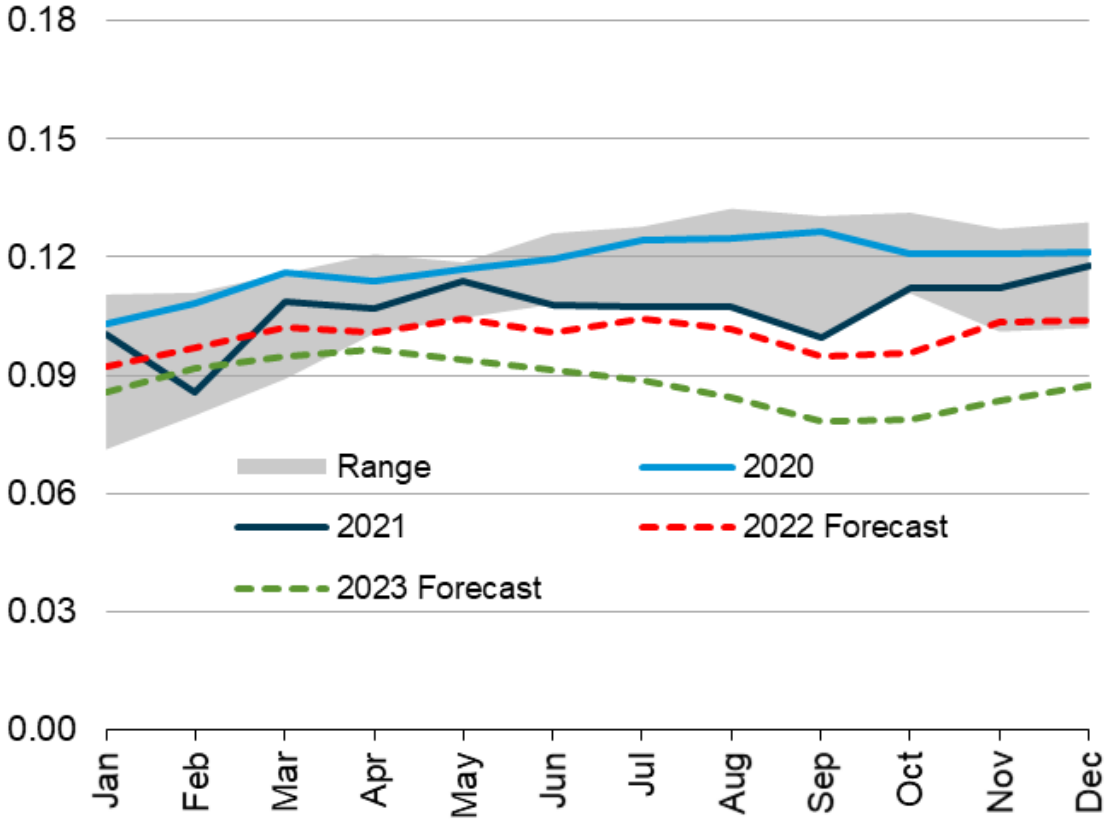
U.S. other biofuels production
million barrels per day



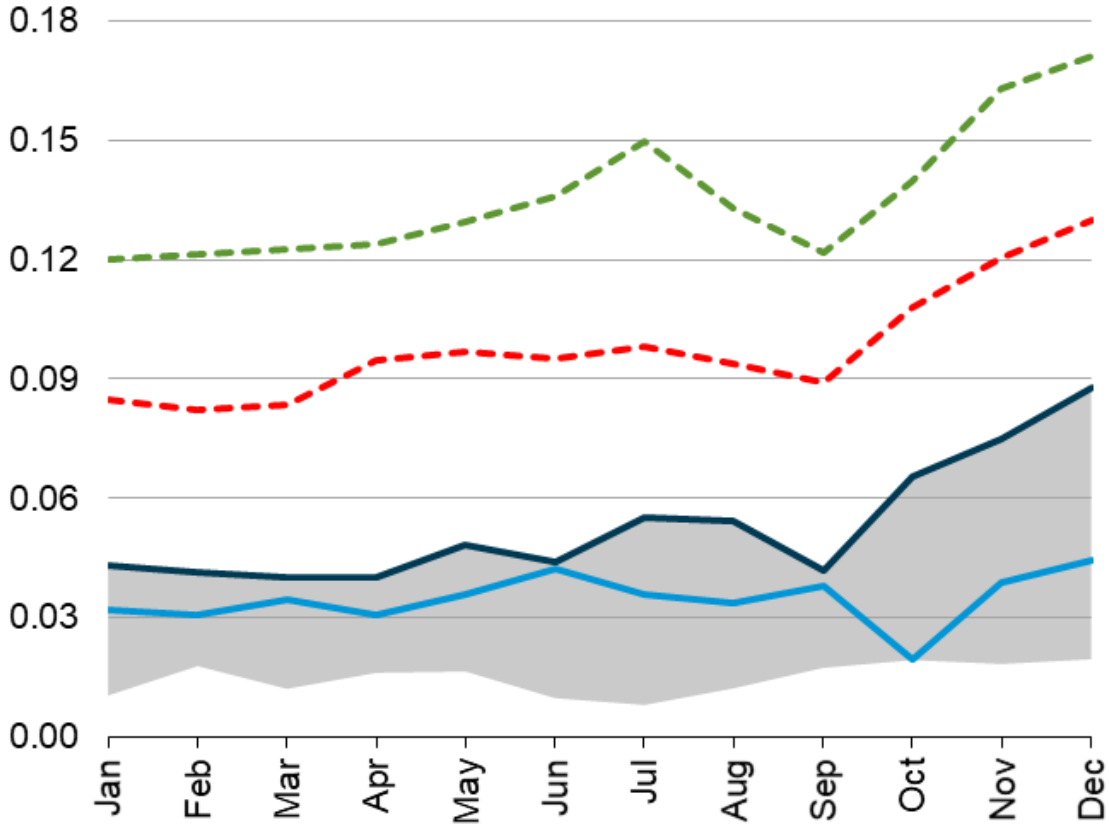
Source: U.S. EIA, *Petroleum Supply Monthly, Short-Term Energy Outlook, August 2022*

MER/PSM and STEO expanded to include renewable diesel in addition to biodiesel in 2021-22

U.S. biodiesel production
million barrels per day

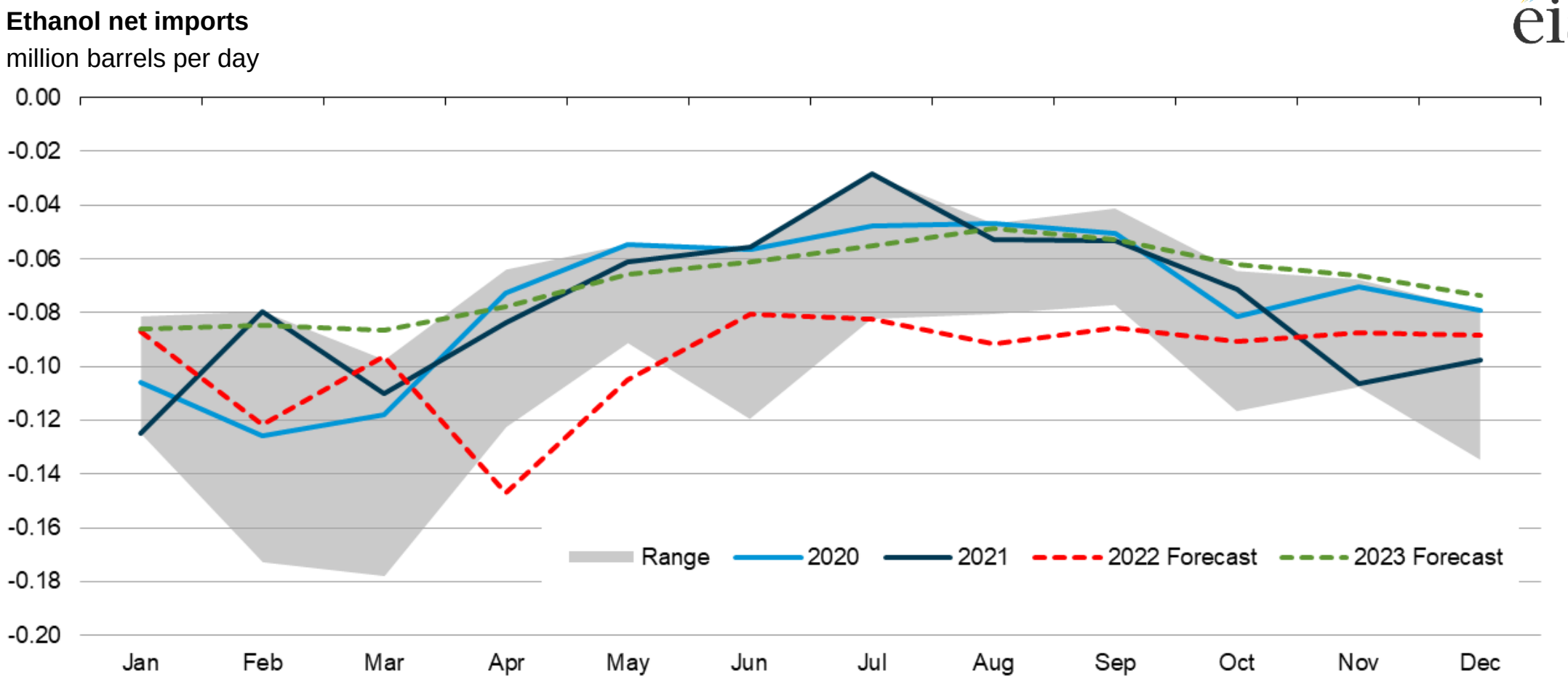


U.S. renewable diesel production
million barrels per day



Source: U.S. EIA, *Petroleum Supply Monthly, Short-Term Energy Outlook, August 2022*

The U.S. is a net exporter of ethanol

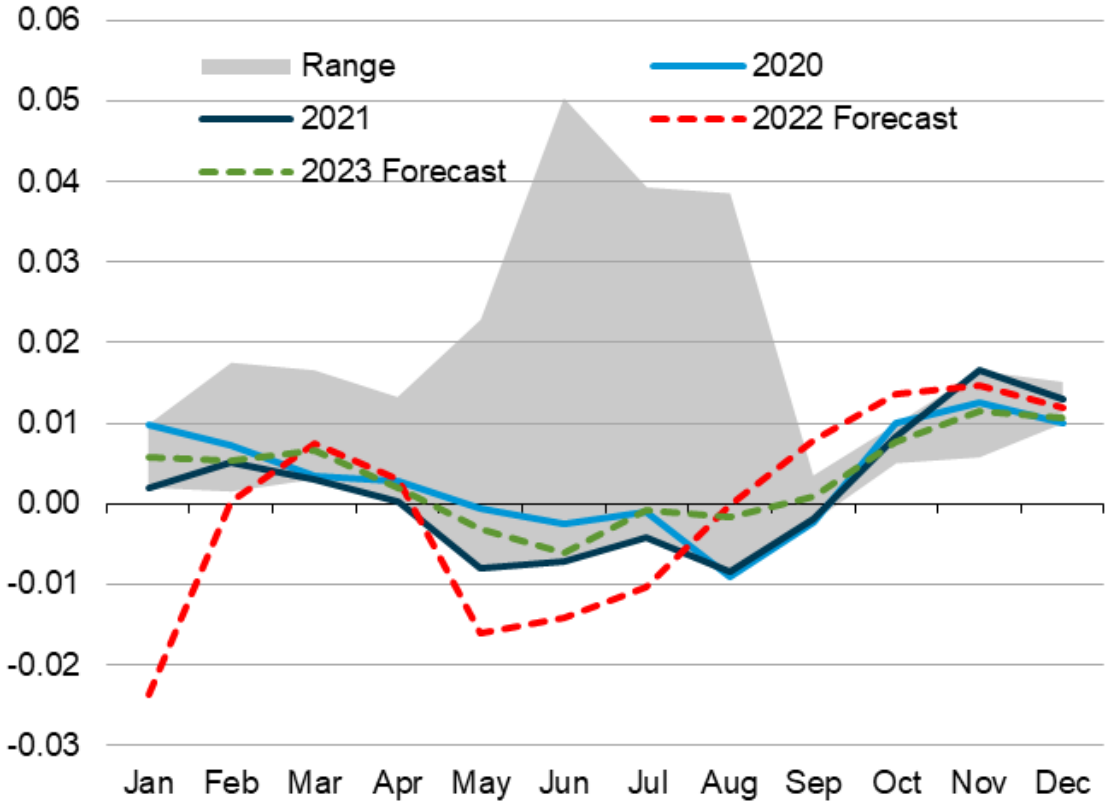


Source: U.S. EIA, *Petroleum Supply Monthly, Short-Term Energy Outlook, October 2022*

U.S. biodiesel imports are comparable to exports; renewable diesel exports are not captured in our data

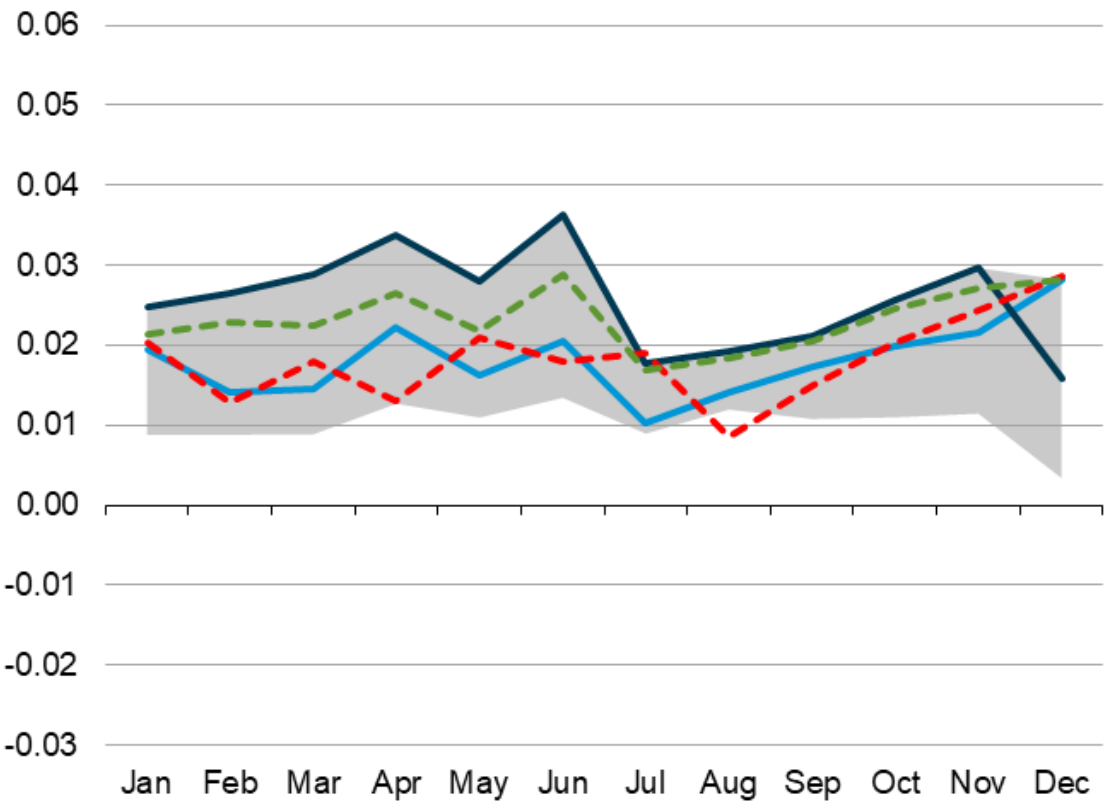
Biodiesel net imports

million barrels per day



Renewable diesel net imports

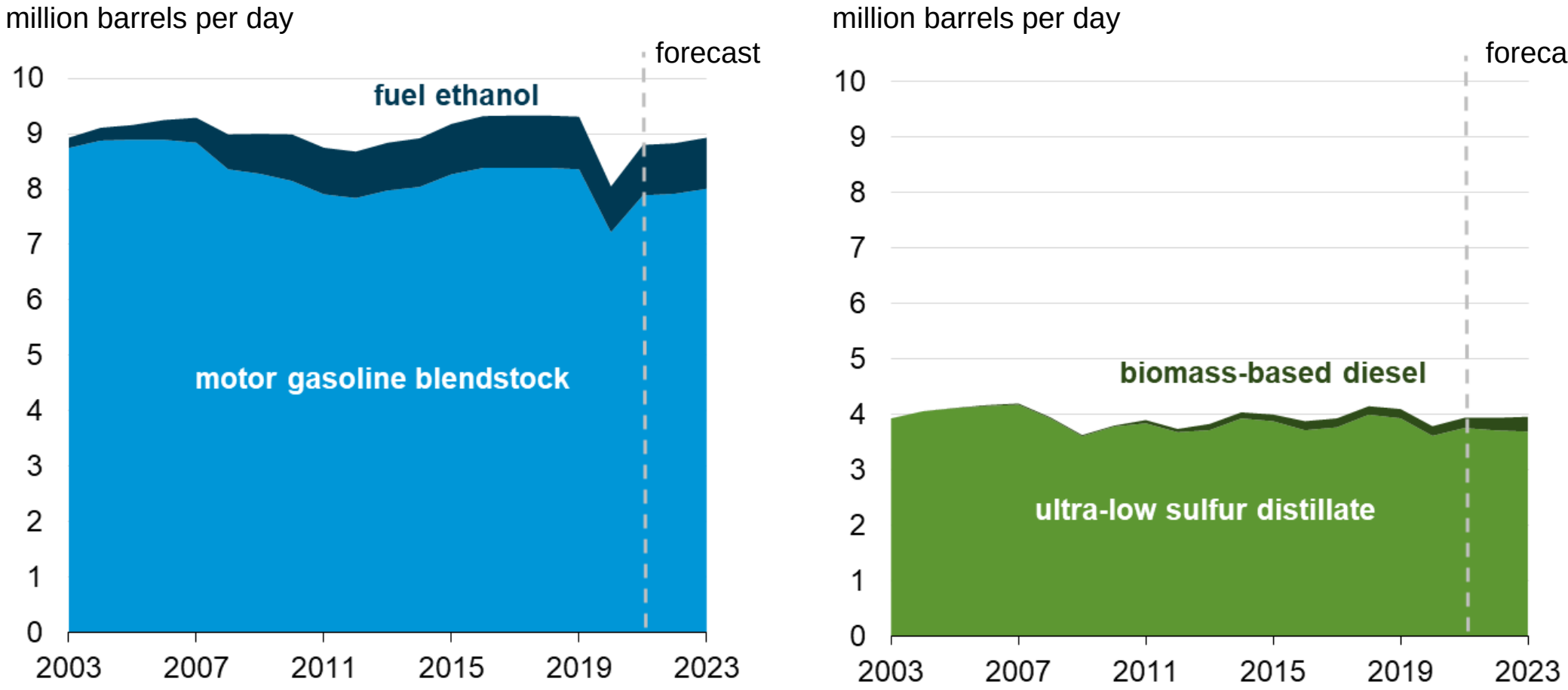
million barrels per day



Source: U.S. EIA, *Petroleum Supply Monthly, Short-Term Energy Outlook, October 2022*

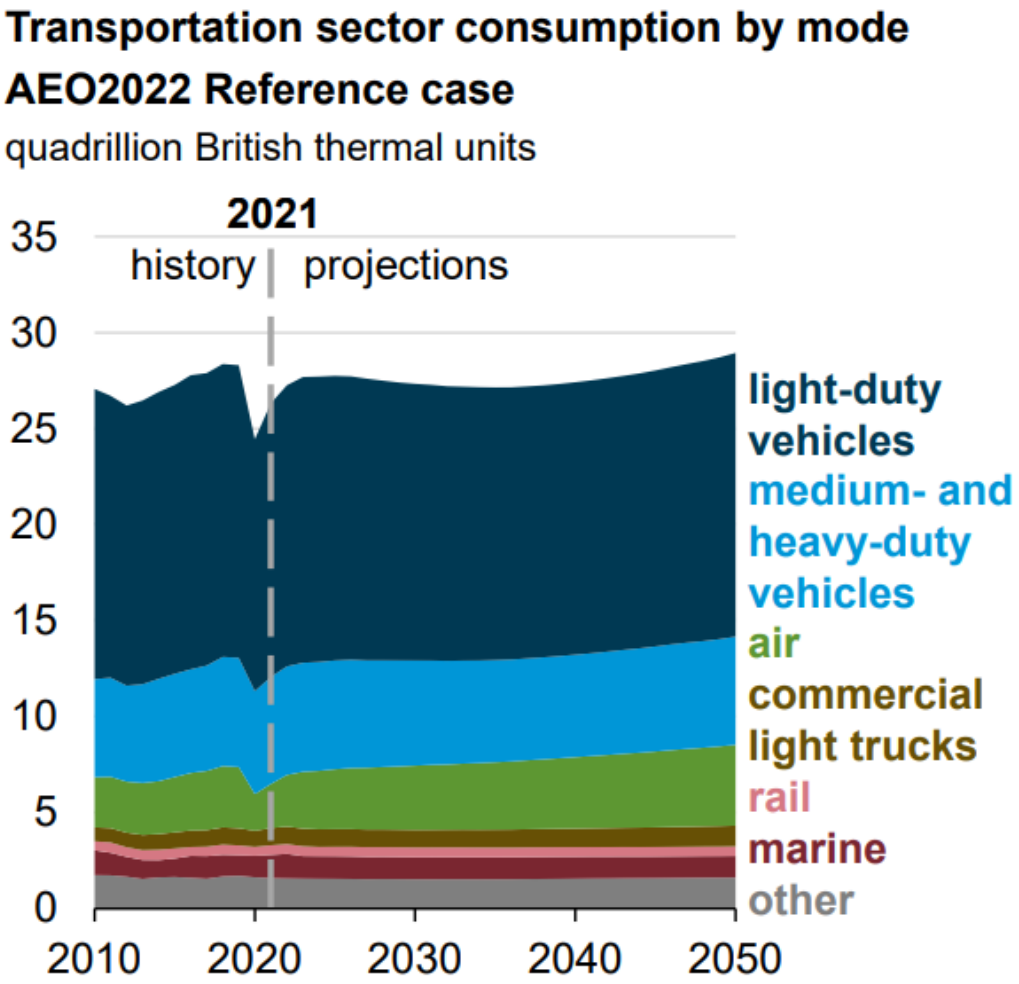
U.S. biofuel blending calculated from EIA data matters for RFS

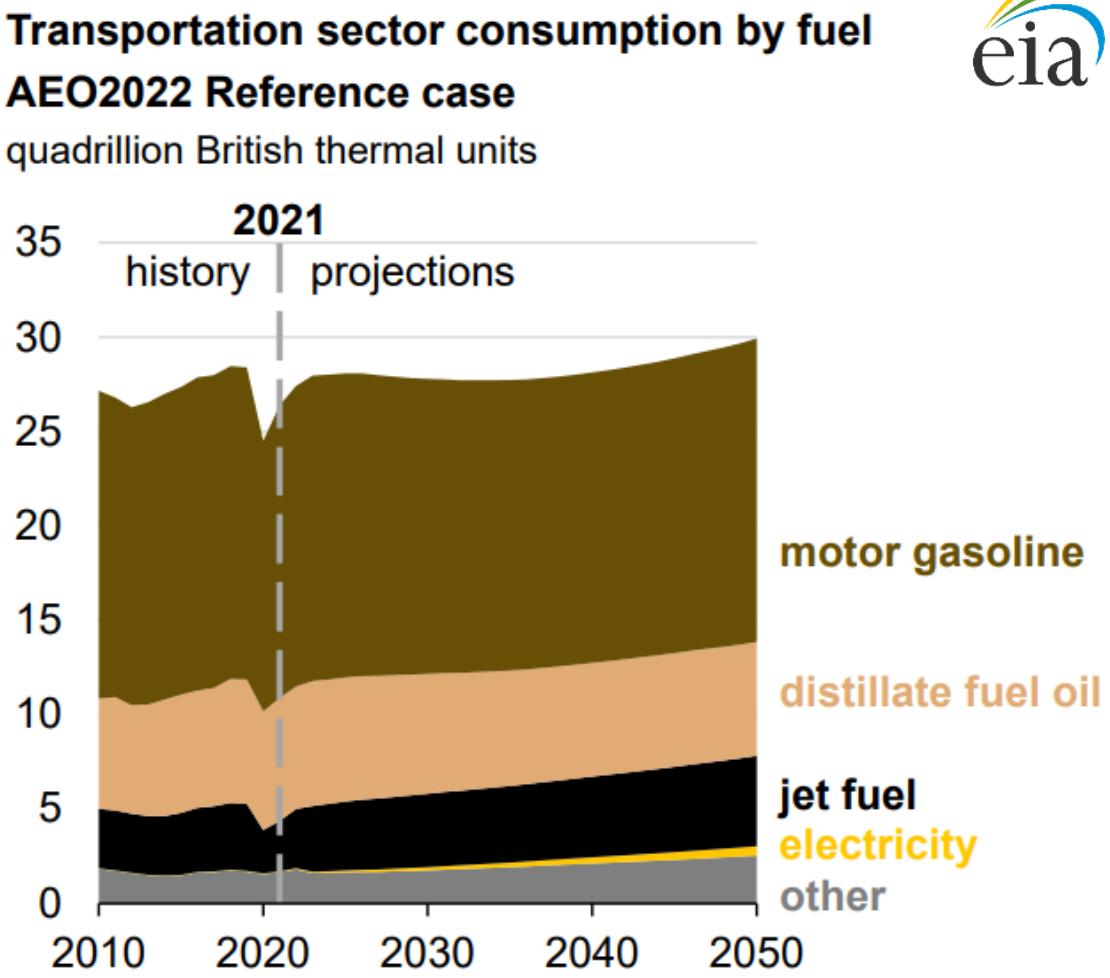
U.S. motor gasoline and diesel consumption (2003-2023)



Source: U.S. EIA, *Petroleum Supply Monthly, Short-Term Energy Outlook, October 2022*

How large is the potential market for biofuels?





Source: *U.S. EIA, Annual Energy Outlook 2022*

Modeling biofuels in Annual Energy Outlook (AEO)

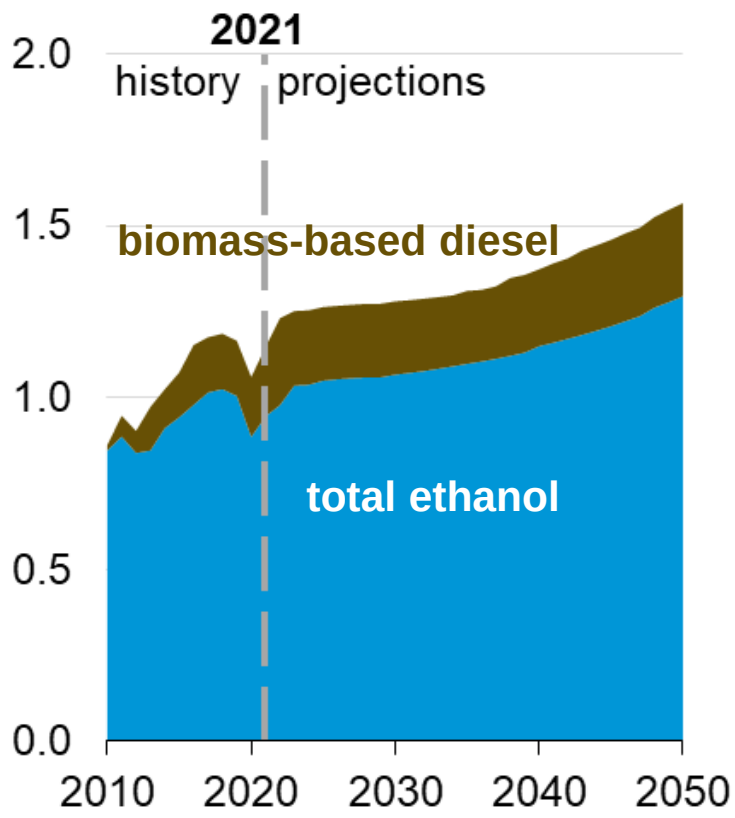
- Liquid Fuels Market Module (LFMM) is a linear program written in GAMS that covers petroleum, biofuels, other liquids
- We model several biofuels in LFMM: ethanol (including E15 and E85), biodiesel, renewable diesel, sustainable aviation fuel*
- We produce outputs of prices and quantities, largely dependent on policy
- We model several policies: RFS, CA Low Carbon Fuel Standard, OR Clean Fuels Program, federal biofuel subsidies
  - Limitations to addressing carbon intensity in NEMS

*Sustainable aviation fuel (SAF) is new to LFMM for AEO2023

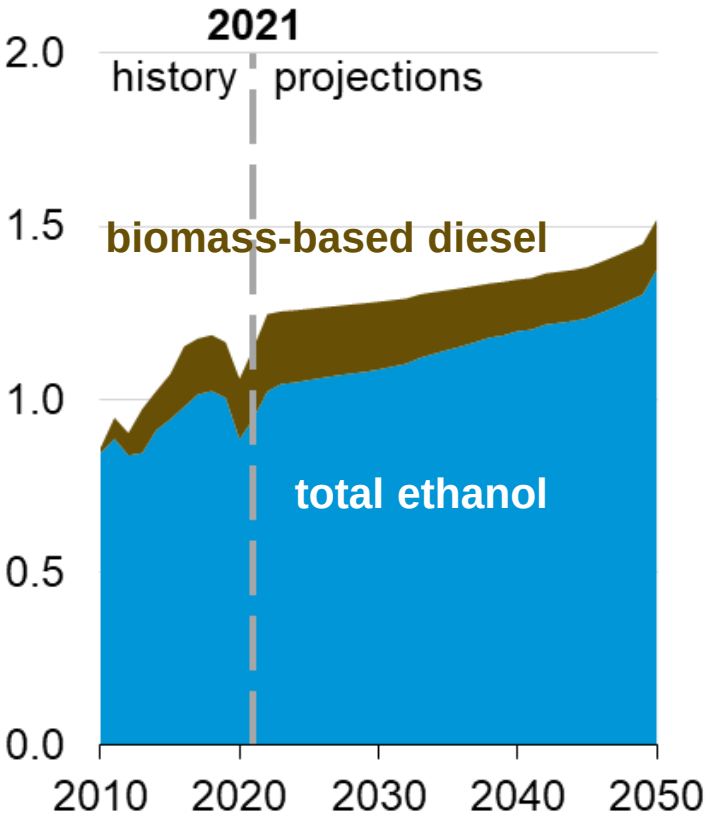
U.S. biofuel production is increasing across all AEO2022 cases

U.S. biofuels production by type, AEO2022 oil price cases

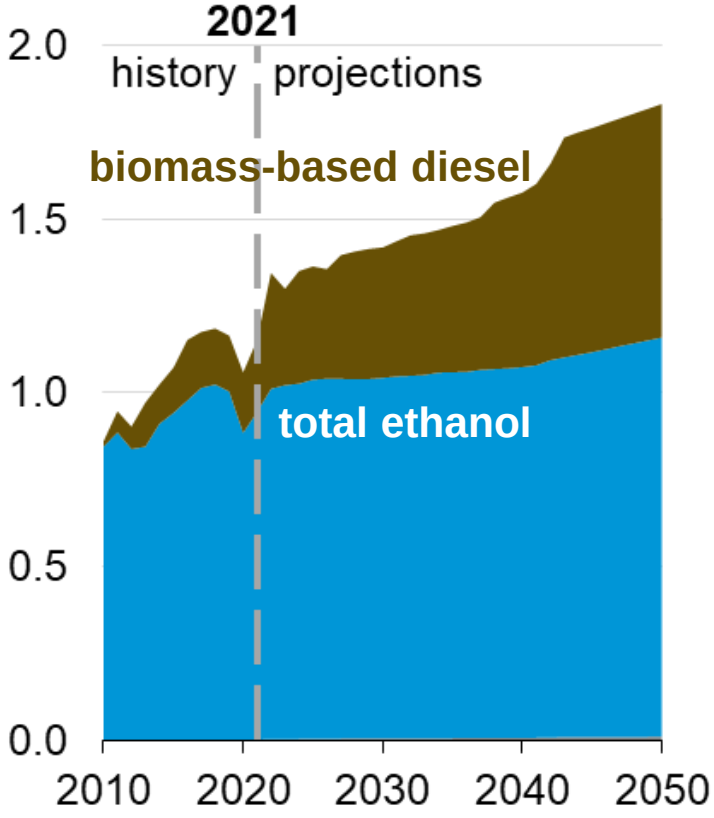
Reference case
million barrels per day



Low Oil Price case
million barrels per day



High Oil Price case
million barrels per day



Note: Other biofuels make up less than 0.2% of biofuel production and are therefore not visible.

Biofuels representation updates/improvements

AEO2022:

- Annual capacity updates for ethanol, biodiesel, renewable diesel
- Renewable Fuels Standard (RFS) mandate
  - U.S. EPA delayed release of final renewable volume obligations (RVO) for 2021 and 2022
  - EIA used the STEO estimate for RVO for years 2021 and 2022

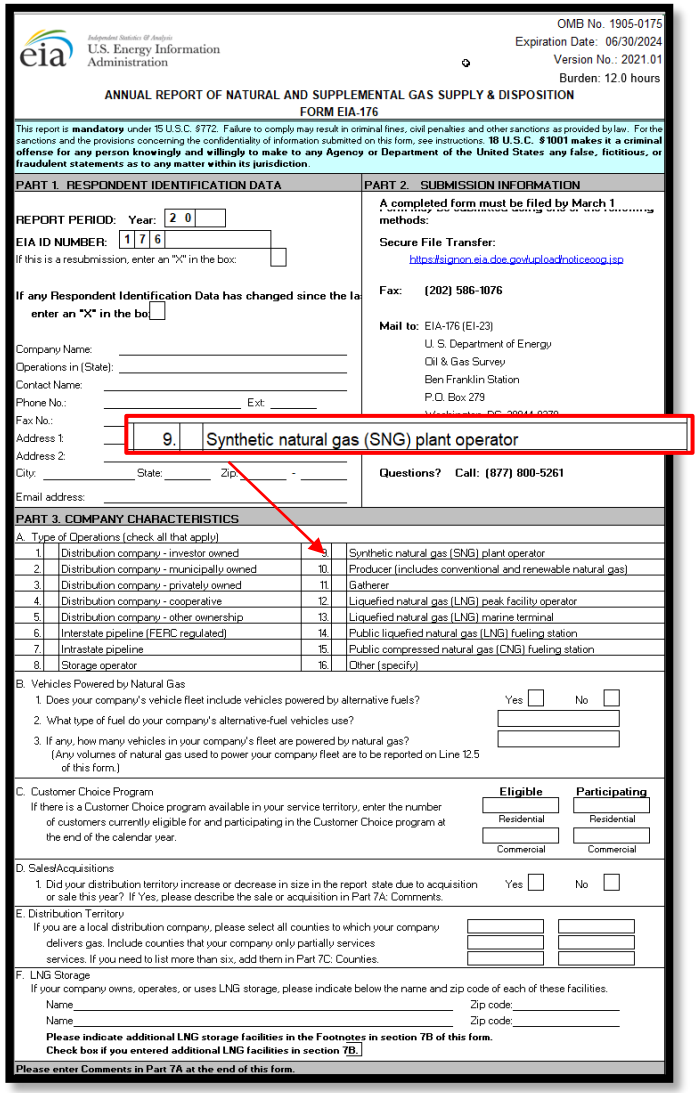
Planned for AEO2023:

- Annual capacity updates
- Bi-annual update of E15 penetration rates
- RFS update based on final rulemaking
- Oregon Clean Fuels Program representation
- Representation of sustainable aviation fuel and Inflation Recovery Act provisions

Biofuels in International Energy Outlook (IEO)

- Historically exogenous analyst judgement
  - Not modeled in any previous models used in IEO
  - Last two IEOs limited to countries where most significant biofuels produced and/or consumed
- Biofuel projections continue trends from International Energy Statistics (IES)
  - Conventional ethanol and biomass-based diesel estimates developed from 3rd-party data
  - Consider major laws enacted, new plant construction, linkages with U.S. bioeconomy
- Biofuels will be estimated exogenously when World Hydrocarbon Activity Model (WHAM) introduced in IEO2023
  - Will consider modeling approaches after WHAM fully integrated into World Energy Projection System (WEPS)

Limited EIA data collection of renewable natural gas means ….



eia Independent Statistics & Analysis U.S. Energy Information Administration

OMB No. 1905-0175
Expiration Date: 06/30/2024
Version No.: 2021.01
Burden: 12.0 hours

ANNUAL REPORT OF NATURAL AND SUPPLEMENTAL GAS SUPPLY & DISPOSITION
FORM EIA-176

This report is **mandatory** under 15 U.S.C. §772. Failure to comply may result in criminal fines, civil penalties and other sanctions as provided by law. For the sanctions and the provisions concerning the confidentiality of information submitted on this form, see instructions. **18 U.S.C. §1001 makes it a criminal offense for any person knowingly and willingly to make to any Agency or Department of the United States any false, fictitious, or fraudulent statements as to any matter within its jurisdiction.**

PART 1. RESPONDENT IDENTIFICATION DATA

REPORT PERIOD: Year: 2 0
EIA ID NUMBER: 1 7 6
If this is a resubmission, enter an "X" in the box:

If any Respondent Identification Data has changed since the la
enter an "X" in the bo

Company Name:
Operations in (State):
Contact Name:
Phone No.: Ext:
Fax No.:
Address 1:
Address 2:
City: State: Zip: -
Email address:

PART 2. SUBMISSION INFORMATION

A completed form must be filed by March 1
methods:

Secure File Transfer:
https://signon.eia.doe.gov/upload/noticeoog.jsp

Fax: (202) 586-1076

Mail to: EIA-176 (EI-23)
U. S. Department of Energy
Oil & Gas Survey
Ben Franklin Station
P.O. Box 279

Questions? Call: (877) 800-5261

PART 3. COMPANY CHARACTERISTICS

A. Type of Operations (check all that apply)

1.	Distribution company - investor owned	9.	Synthetic natural gas (SNG) plant operator
2.	Distribution company - municipally owned	10.	Producer (includes conventional and renewable natural gas)
3.	Distribution company - privately owned	11.	Gatherer
4.	Distribution company - cooperative	12.	Liquefied natural gas (LNG) peak facility operator
5.	Distribution company - other ownership	13.	Liquefied natural gas (LNG) marine terminal
6.	Interstate pipeline (FERC regulated)	14.	Public liquefied natural gas (LNG) fueling station
7.	Intrastate pipeline	15.	Public compressed natural gas (CNG) fueling station
8.	Storage operator	16.	Other (specify)

B. Vehicles Powered by Natural Gas
1. Does your company's vehicle fleet include vehicles powered by alternative fuels? Yes No
2. What type of fuel do your company's alternative-fuel vehicles use?
3. If any, how many vehicles in your company's fleet are powered by natural gas? (Any volumes of natural gas used to power your company fleet are to be reported on Line 12.5 of this form.)

C. Customer Choice Program
If there is a Customer Choice program available in your service territory, enter the number of customers currently eligible for and participating in the Customer Choice program at the end of the calendar year.

	Eligible	Participating
Residential		
Commercial		

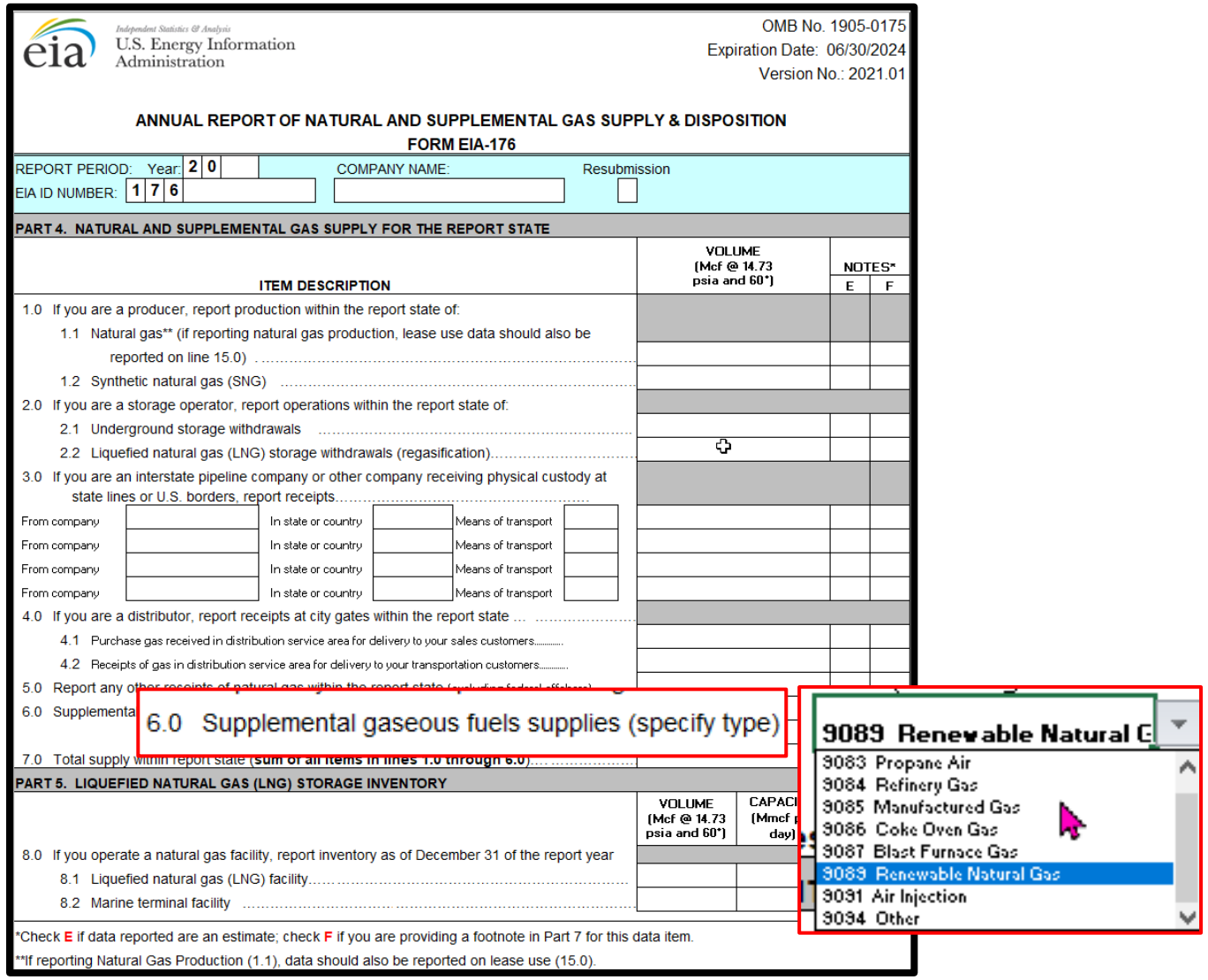
D. Sales/Acquisitions
1. Did your distribution territory increase or decrease in size in the report state due to acquisition or sale this year? If Yes, please describe the sale or acquisition in Part 7A: Comments. Yes No

E. Distribution Territory
If you are a local distribution company, please select all counties to which your company delivers gas. Include counties that your company only partially services services. If you need to list more than six, add them in Part 7C: Counties.

F. LNG Storage
If your company owns, operates, or uses LNG storage, please indicate below the name and zip code of each of these facilities.
Name Zip code:
Name Zip code:
Please indicate additional LNG storage facilities in the Footnotes in section 7B of this form.
Check box if you entered additional LNG facilities in section 7B.

Please enter Comments in Part 7A at the end of this form.

9. Synthetic natural gas (SNG) plant operator



eia Independent Statistics & Analysis U.S. Energy Information Administration

OMB No. 1905-0175
Expiration Date: 06/30/2024
Version No.: 2021.01

ANNUAL REPORT OF NATURAL AND SUPPLEMENTAL GAS SUPPLY & DISPOSITION
FORM EIA-176

REPORT PERIOD: Year: 2 0 COMPANY NAME: Resubmission
EIA ID NUMBER: 1 7 6

PART 4. NATURAL AND SUPPLEMENTAL GAS SUPPLY FOR THE REPORT STATE

ITEM DESCRIPTION	VOLUME (Mcf @ 14.73 psia and 60°)	NOTES* E	NOTES* F
1.0 If you are a producer, report production within the report state of:			
1.1 Natural gas** (if reporting natural gas production, lease use data should also be reported on line 15.0)			
1.2 Synthetic natural gas (SNG)			
2.0 If you are a storage operator, report operations within the report state of:			
2.1 Underground storage withdrawals			
2.2 Liquefied natural gas (LNG) storage withdrawals (regasification)			
3.0 If you are an interstate pipeline company or other company receiving physical custody at state lines or U.S. borders, report receipts			
From company ___ In state or country ___ Means of transport ___			
From company ___ In state or country ___ Means of transport ___			
From company ___ In state or country ___ Means of transport ___			
From company ___ In state or country ___ Means of transport ___			
4.0 If you are a distributor, report receipts at city gates within the report state			
4.1 Purchase gas received in distribution service area for delivery to your sales customers			
4.2 Receipts of gas in distribution service area for delivery to your transportation customers			
5.0 Report any other receipts of natural gas within the report state (excluding federal offshore)			
6.0 Supplemental gaseous fuels supplies (specify type)			
7.0 Total supply within report state (sum of all items in lines 1.0 through 6.0)			

PART 5. LIQUEFIED NATURAL GAS (LNG) STORAGE INVENTORY

	VOLUME (Mcf @ 14.73 psia and 60°)	CAPACI (Mmcf day)
8.0 If you operate a natural gas facility, report inventory as of December 31 of the report year		
8.1 Liquefied natural gas (LNG) facility		
8.2 Marine terminal facility		

*Check **E** if data reported are an estimate; check **F** if you are providing a footnote in Part 7 for this data item.
**If reporting Natural Gas Production (1.1), data should also be reported on lease use (15.0).

6.0 Supplemental gaseous fuels supplies (specify type)

9089 Renewable Natural G
9083 Propane Air
9084 Refinery Gas
9085 Manufactured Gas
9086 Coke Oven Gas
9087 Blast Furnace Gas
9089 Renewable Natural Gas
9091 Air Injection
9094 Other

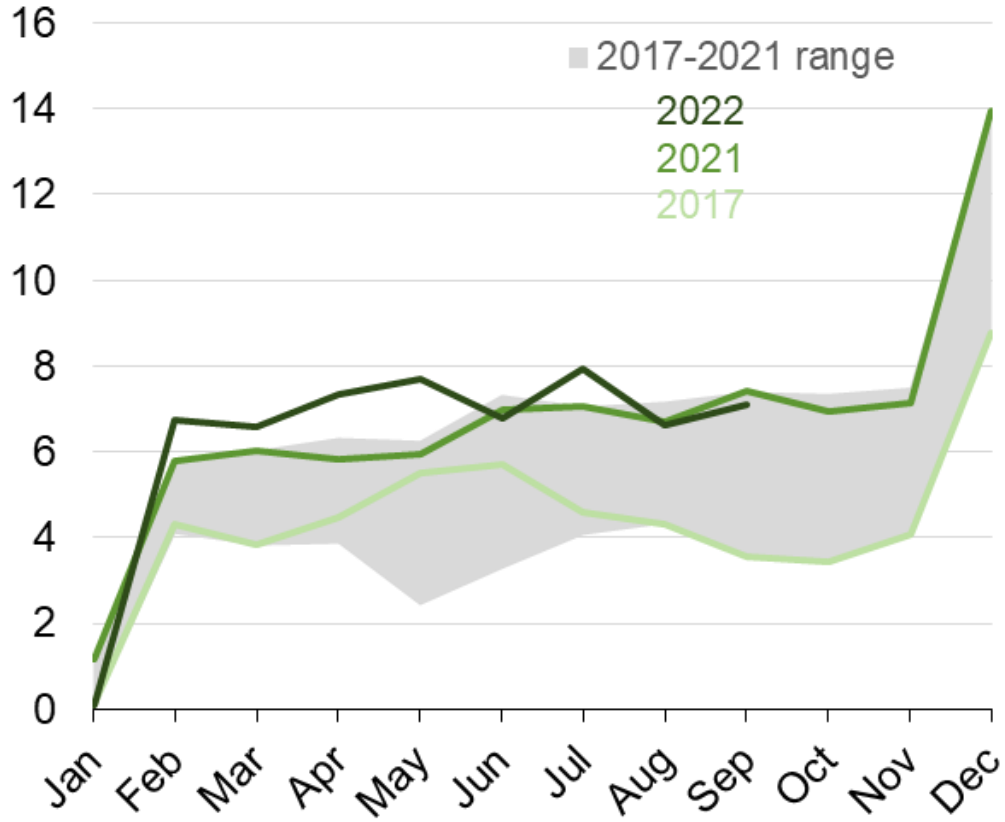
Source: EIA-176 form parts 1-3, 4

Limited renewable natural gas data from EIA

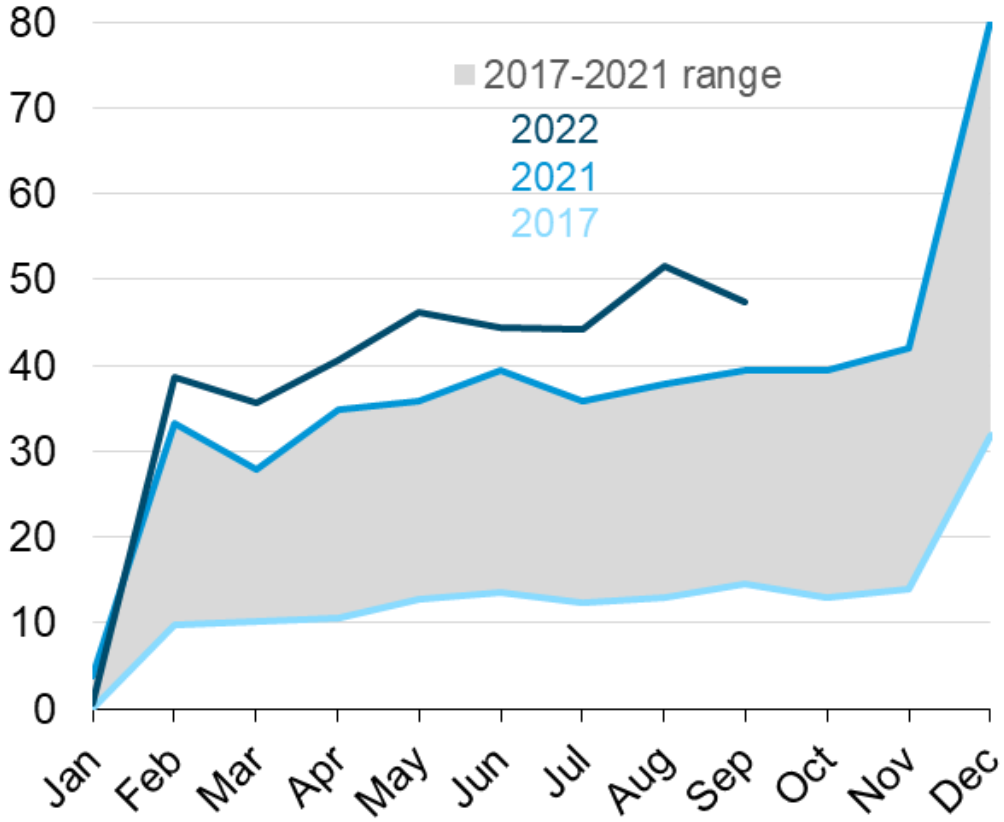
- Annual supplemental gas (biomass) supplies reporting on Natural Gas Annual
  - Biomass gas ~ 3% of total supplemental supplies (< 0.2% of total gas production)
  - No monthly reporting
- Supplemental gaseous fuels are forecast in monthly Short-term Energy Outlook (STEO)
  - Select data through Customize Table
- Supplemental natural gas is projected in Annual Energy Outlook (AEO) with no growth
- Landfill gas used by independent power producers for power generation and combined heat and power is collected monthly on EIA-923, but none of the gas enters the pipeline system
- Municipal waste (Industry) and biogenic municipal waste (Electricity) use are projected in AEO

EMTS volumes from RINs generated for renewable natural gas (RNG) indicate holes in EIA data collection

Liquefied RNG production
million ethanol gallon equivalent



Compressed RNG production
million ethanol gallon equivalent



Source: EPA EMTS 11/2/22.

EIA renewable natural gas (biomass gas) production data available in annual Supplemental gas supplies

Supplemental Gas Supplies

(Million Cubic Feet)

Area: U.S. **Period:** Annual

Download Series History | Definitions, Sources & Notes

Show Data By: Product / Area	Graph / Clear	2016	2017	2018	2019	2020	2021	View History
Total		57,188	65,696	69,343	60,766	63,146	66,044	1980-2021
Synthetic		50,922	59,028	61,889	53,837	54,566	54,429	1980-2021
Propane-Air		1,031	1,724	1,559	681	258	3,093	1980-2021
Refinery Gas								1980-2005
Biomass		1,135	760	780	791	1,976	2,035	1993-2021
Other		4,100	4,185	5,115	5,458	6,346	6,487	1980-2021

Click on the source key icon to learn how to download series into Excel, or to embed a chart or map on your website.

- = No Data Reported; -- = Not Applicable; **NA** = Not Available; **W** = Withheld to avoid disclosure of individual company data.

Notes: See Definitions, Sources, and Notes link above for more information on this table.

Release Date: 10/31/2022
Next Release Date: 11/30/2022

Today in Energy and This Week in Petroleum articles of interest

Petroleum

- 2020 refinery closures: https://www.eia.gov/todayinenergy/detail.php?id=48636
- Gasoline near record highs: https://www.eia.gov/todayinenergy/detail.php?id=52538
- East Coast gasoline inventories: https://www.eia.gov/todayinenergy/detail.php?id=53879
- East Coast retail diesel: https://www.eia.gov/todayinenergy/detail.php?id=52459

Renewable fuels

- Expanded biofuels data in MER: https://www.eia.gov/todayinenergy/detail.php?id=50416
- RD data added to STEO: https://www.eia.gov/todayinenergy/detail.php?id=51419
- AEO 2022 RD production: https://www.eia.gov/todayinenergy/detail.php?id=51778
- Ethanol production by state: https://www.eia.gov/todayinenergy/detail.php?id=53539
- Ethanol mostly transported by rail: https://www.eia.gov/todayinenergy/detail.php?id=54279
- High RIN prices 2022: https://www.eia.gov/todayinenergy/detail.php?id=53019

For further information

Weekly Petroleum Status Report | www.eia.gov/petroleum/supply/weekly

This Week in Petroleum | https://www.eia.gov/petroleum/weekly/

Petroleum Supply Monthly | www.eia.gov/petroleum/supply/monthly

Natural Gas Annual | https://www.eia.gov/naturalgas/annual/

Monthly Energy Report | https://www.eia.gov/totalenergy/data/monthly/

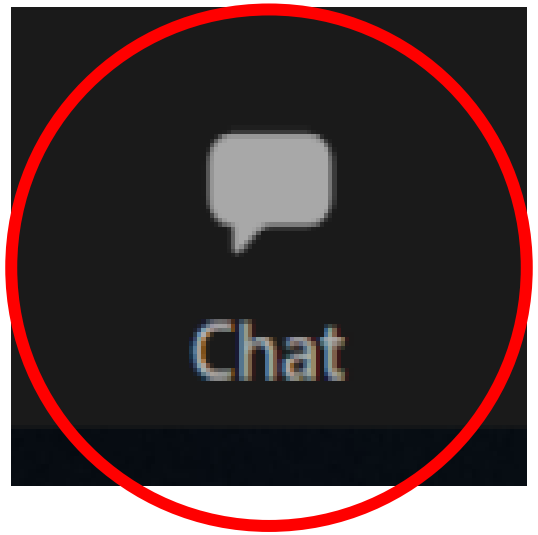
Short-Term Energy Outlook | www.eia.gov/steo

Annual Energy Outlook | www.eia.gov/aeo

International Energy Outlook | www.eia.gov/ieo

International Energy Statistics | www.eia.gov/beta/international

Questions



At the conclusion of each panel DEEP will hold a brief question and answer period.

If you have a question for a presenter, please drop it into the chat to **Jeff Howard**. DEEP will pose as many questions as time allows to the speakers. Clarifying questions will be prioritized. Leading questions will not be accepted.

Benefits of Alternative Fuels

Stephen Dodge, Dr. Thomas Butcher, Richard A. Lyons – Clean Fuels Alliance America (CFAA), National Oilheat Research Alliance (NORA), & Carlin Combustion Technology

Sam Lehr – Renewable Natural Gas (RNG) Coalition

Nikki Bruno, Eric Bosworth, and Tamara Becejac – Eversource & Avangrid

Leslie Anderson – Propane Gas Association of New England

Gabrielle Frigon & Elizabeth Moore – Bureau of Materials Management & Compliance Assurance – CT DEEP

(speaker order may vary)

BUREAU OF ENERGY AND TECHNOLOGY POLICY

Clean Fuels Alliance America (CFAA), National Oilheat Research Alliance (NORA), & Carlin Combustion Technology

Clean Fuels ALLIANCE AMERICA

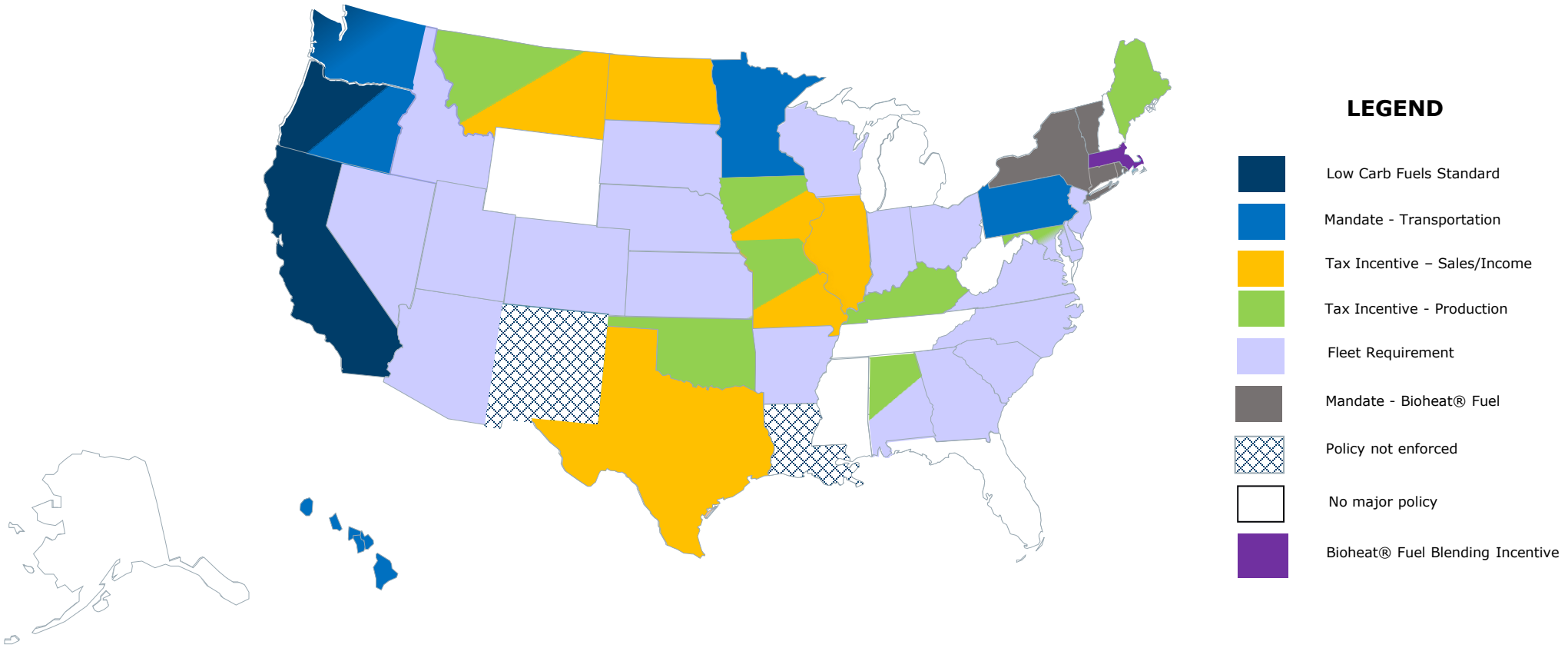
CLEAN FUELS ALLIANCE AMERICA

- 30-year-old organization.
- Today, 5% of the distillate market.
  - 3.2 billion gallons in 2021.
- Focus on sustainable growth for new market demands.

Biodiesel, renewable diesel, and sustainable aviation fuel will be recognized as mainstream low-carbon fuel options with superior performance and emission characteristics. In on-road, off-road, air transportation, electricity generation, and home heating applications, use ***will exceed six billion gallons by 2030,*** eliminating over 35 million metric tons of CO2 equivalent greenhouse gas emissions annually. With advancements in feedstock, use will reach 15 billion gallons by 2050.

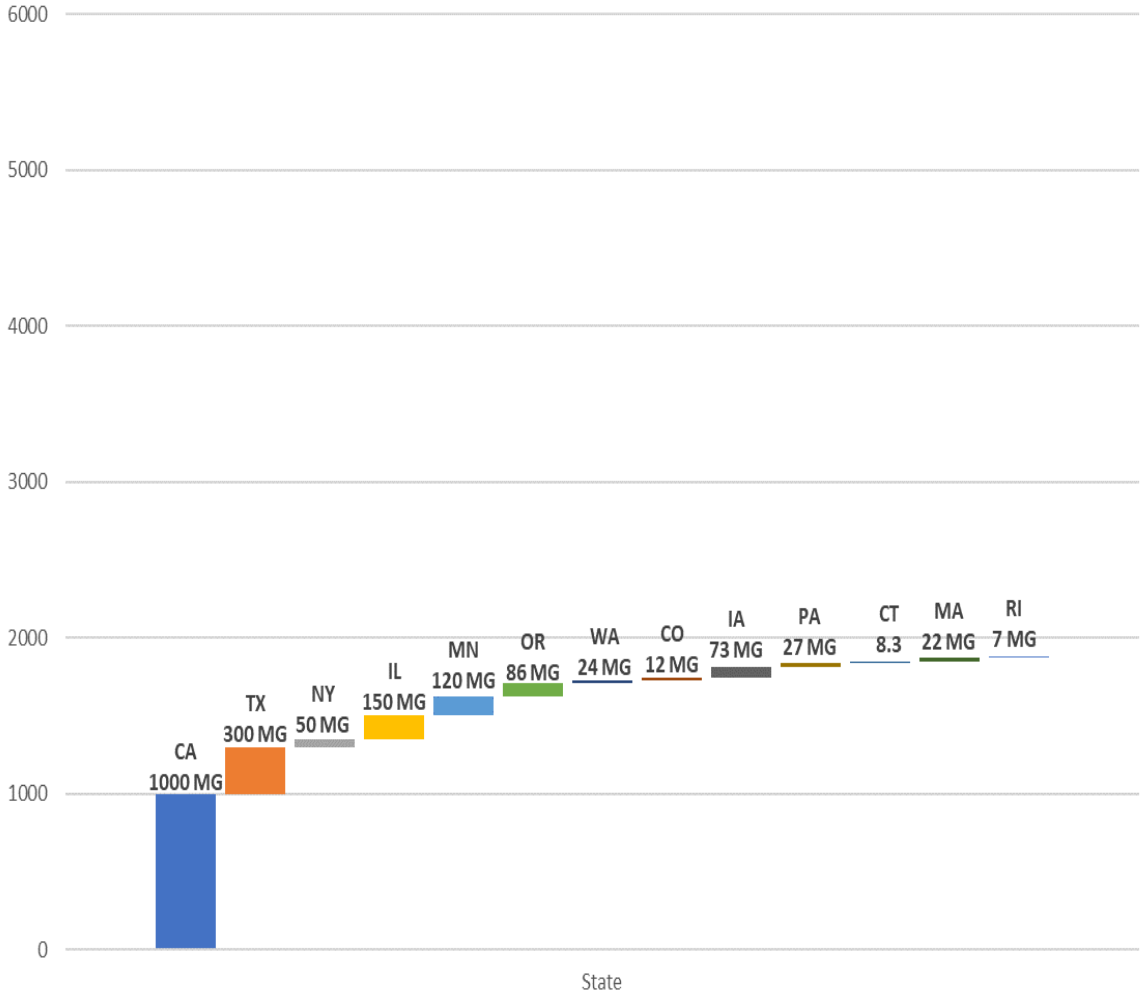
Clean Fuels ALLIANCE AMERICA

STATES WITH NOTABLE BIODIESEL POLICIES

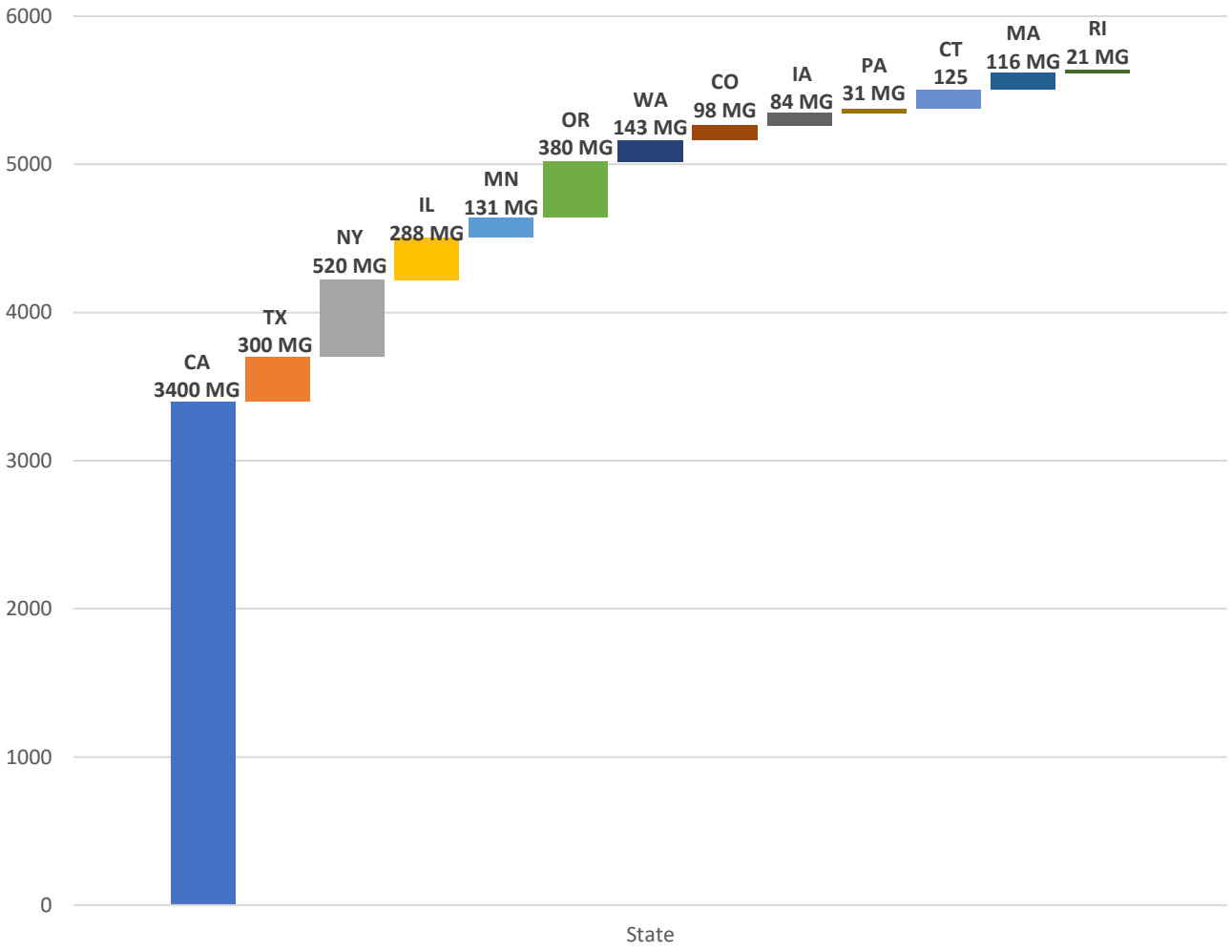


Current as of 10/11/2022
Data from DOE Alternative Fuels Data Center and Individual State Statues

2020 1.9 Billion Gallon State Market



2030* 5.6 Billion Gallon State Market

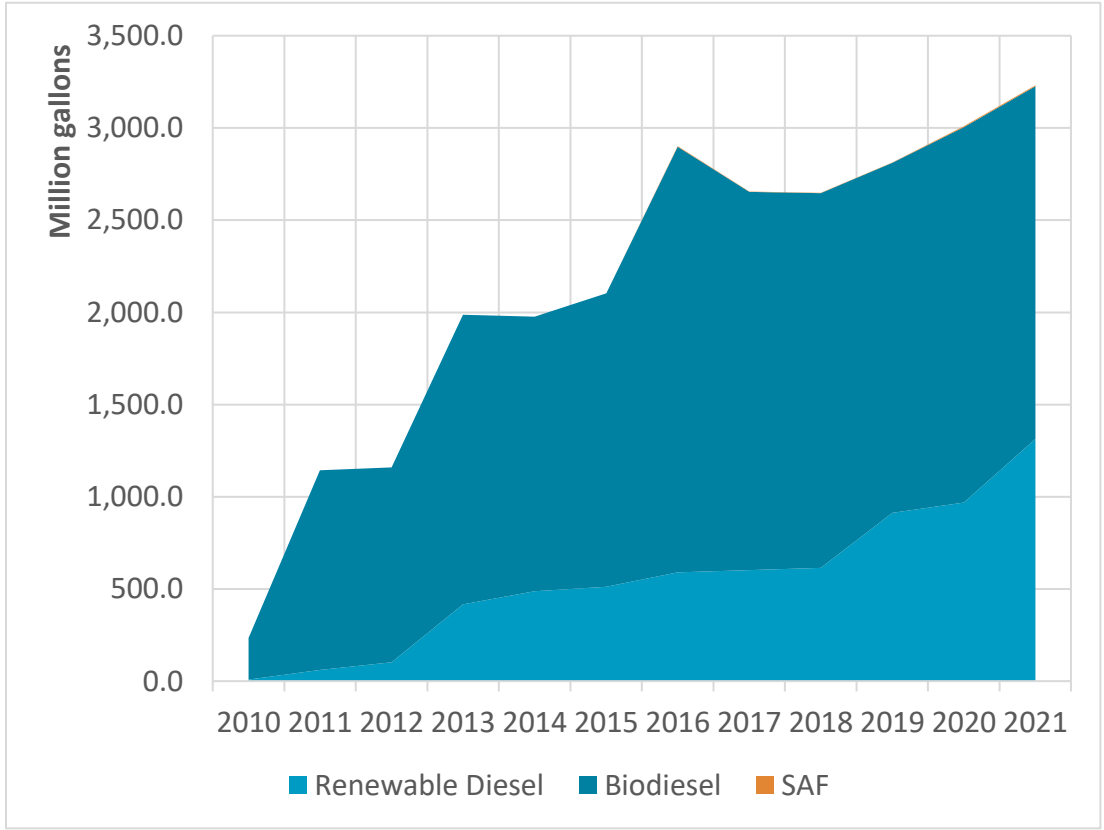


*Potential growth based on established or proposed requirements

ALLIANCE AMERICA

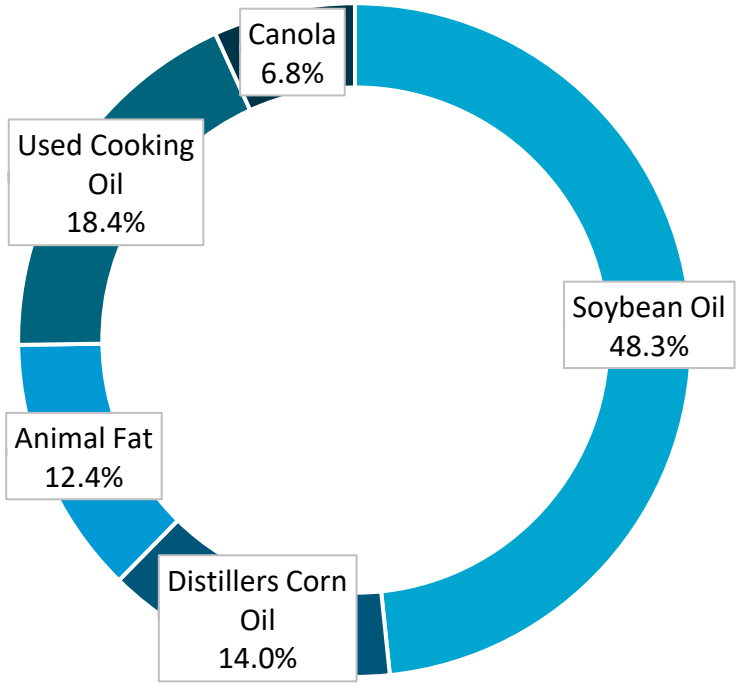
CLEAN FUELS' VISION

- By 2030 – 6 billion gallons with new markets.
  - Home heating
  - Jet fuel
  - Rail
  - Ocean-going shipping
- Factors driving industry growth:
  - Demand for immediate carbon reductions.
    - Federal Policy
    - State Policy
    - Corporate Policy
  - Energy security – overreliance on oil imports from unfriendly regions.
  - Changing energy markets.
  - Changing agricultural markets.



FEEDSTOCK MARKET

Clean Fuels Feedstocks – 2021



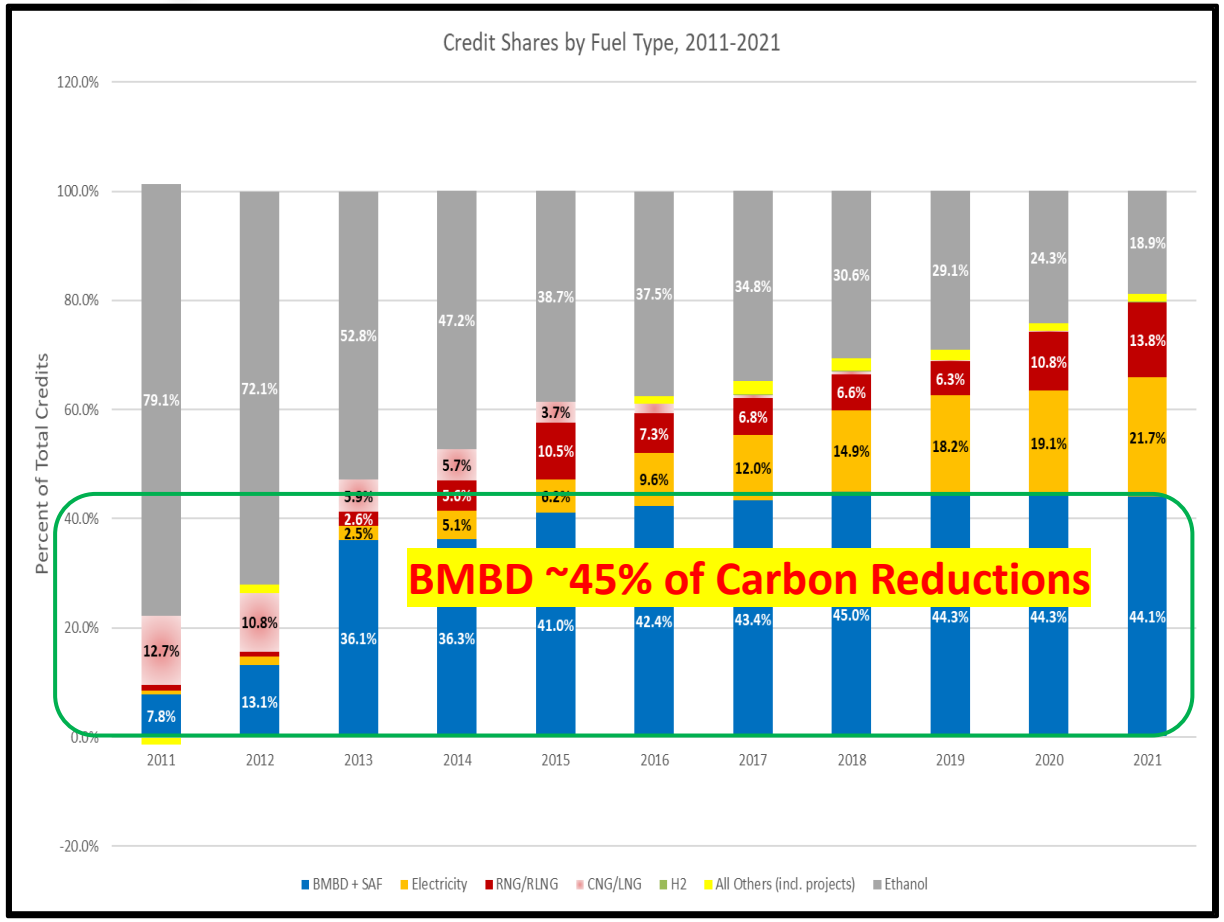
- LMC analysis: feedstock supplies in North America to 2025.
- Did not factor in yield improvements or additional feedstock supplies via global trade.
- Suitable BBD feedstocks from 41.1 to 55 billion lbs., a total increase of 14 billion lbs. in 2022-2025 period.
- Up to 1.866 billion additional gallons of biomass-based diesel could be generated.

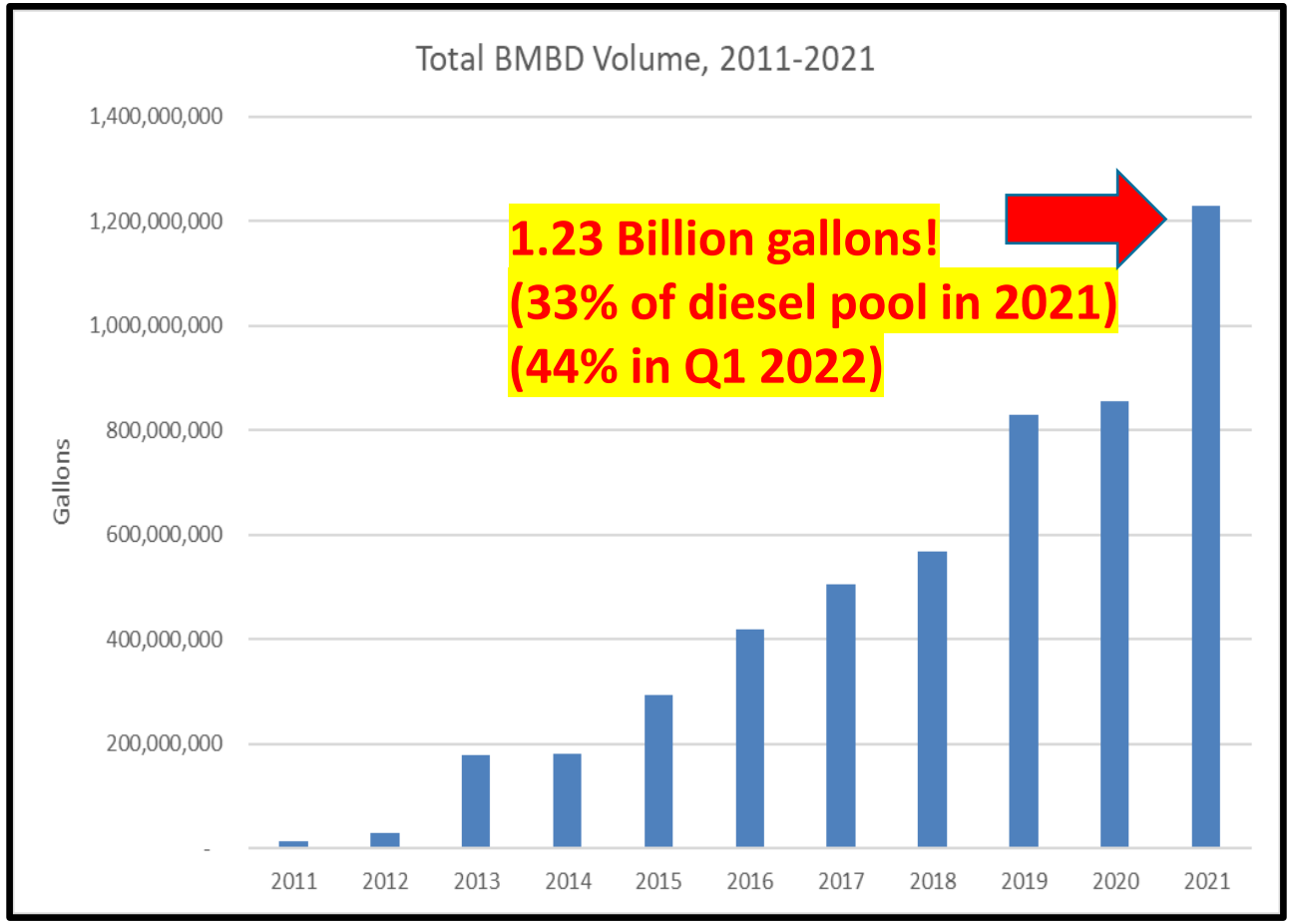
ACCORDING TO CARB:

- "...the transportation sector also had the steepest decline in 2020, dropping 16%, likely a result of the shelter-in-place orders and a consequent drop in vehicle miles traveled. This decline in greenhouse gas emissions was also buoyed by an 18% growth in electric cars, a continuing improvement in the overall fuel efficiency of cars in the state, **and the continuing rise of the use of bio- and renewable diesel fuel for heavy-duty trucks which now constitute 21% of all diesel fuel sold in the state in 2020.**

Clean Fuels
ALLIANCE AMERICA

DROP-IN, LOW CARBON BMBD TRANSLATES TO CRITICAL ROLE IN LCFS

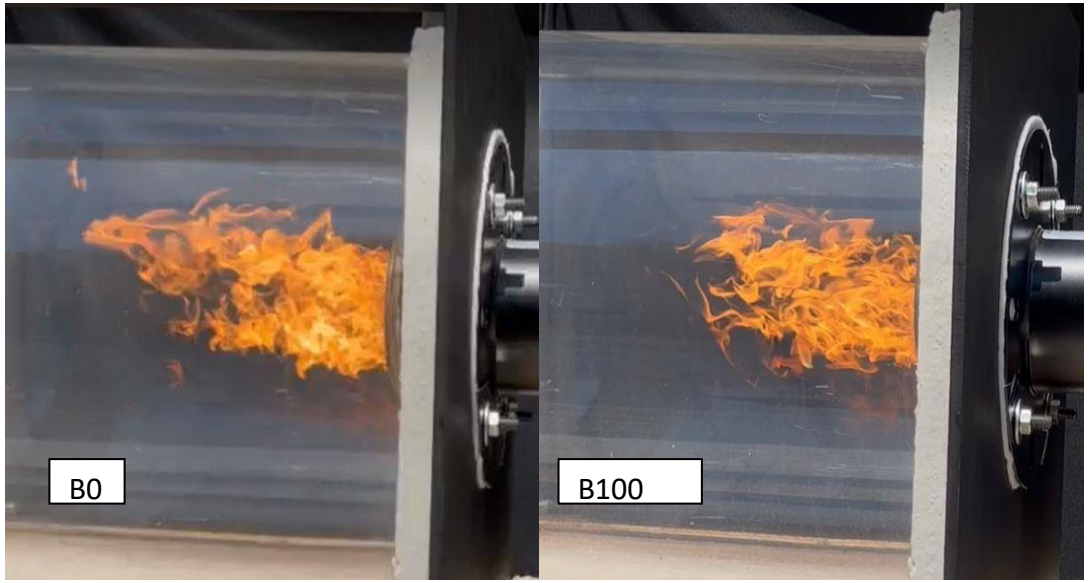




Biodiesel Blends for Heating

Connecticut Comprehensive Energy Strategy
Meeting 6 – Alternative Fuels
November 4, 2022

Tom Butcher, Technical Director
National Oilheat Research Alliance

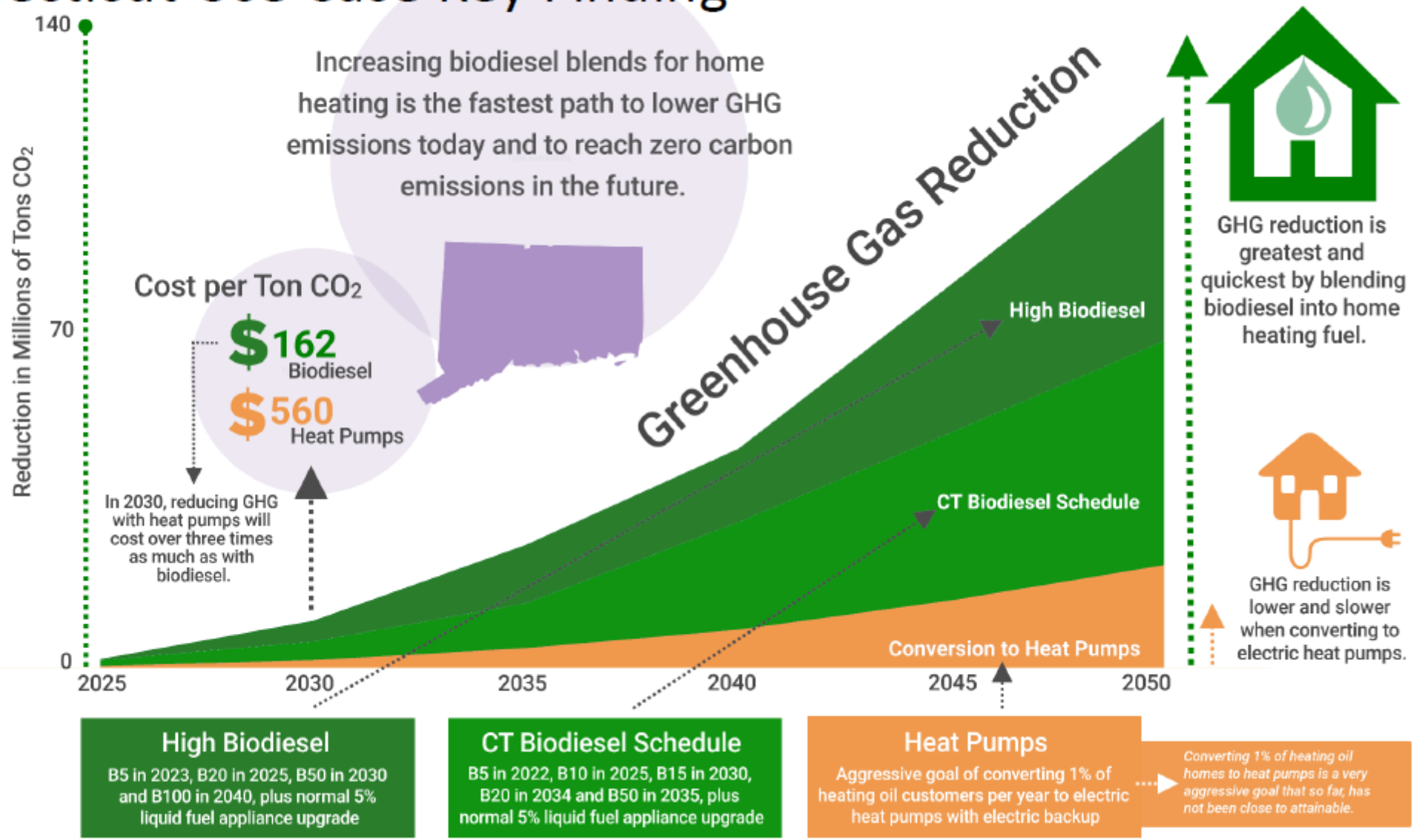


NORA NORAweb.org
NATIONAL OILHEAT RESEARCH ALLIANCE

Current Status – Biodiesel for Heating

- ASTM Standards define the properties of biodiesel fuel (B100 -ASTM D6751), heating fuel with up to 5% biodiesel, and heating fuels with up to 20% biodiesel (B20 – ASTM D396).
- Underwriters Laboratories (UL) has a formal test procedure in-place for “listing” approval of burners which can use B20. At least three burner manufacturers have listed B20 burners.
- UL is now finalizing a formal test procedure for listing approval of burners which can use B100.
- The number of homes currently using B20 is in the hundreds of thousands. The largest U.S. home heating marketers has committed to converting their 350,000 customers to B20 and this is in progress.
- 9,000 homes are currently using B50 blends.
- Approximately 125 U.S. homes are currently piloting the use of B100.

Connecticut Use Case Key Finding



Zero-Carbon Home Concept with Biodiesel

- Concept under development to showcase a low cost, heat pump-free zero-carbon home retrofit;
- Conversion of high efficiency boiler to B100 (based on UCO, 90% GHG reduction);
- PV array sized to 120% of annual usage;
- Excess feedback to grid offsets B100 GHG contribution.

Thank you!

Tom Butcher
tbutcher@noraweb.org
(571) 234 7756

www.noraweb.org

NORAweb.org
NATIONAL OILHEAT RESEARCH ALLIANCE

C. Cowles & Co.

Richard Lyons - President

Located in North Haven, CT

- **Hydrolevel Company**
- **Carlin Combustion Technology**

We manufacture oil, biofuel and gas burners and controls for residential and commercial space heating and water heating applications.

Carlin is one of three burner manufacturers serving the residential oil heating market.

Carlin® Combustion Technology HYDROLEVEL COMPANY

Our Journey with Biofuels

- Carlin always supported early adopters - but we did so with healthy skepticism
- First, we had to be convinced . . .
  - NORA and early adopters led the way with extensive lab and field testing
  - Creation of an ASTM fuel standard
  - Development of a UL Standard for B20 equipment
- Carlin Launched UL Listed B20 Burners in February of 2021
- Many oil dealers (including the industry's largest) are now supplying B20 to their customers

What's Next . . .

- Carlin plans to launch a UL Listed B100 burner in the next 12 months
  - Carlin began testing higher blends including B100 two and a half years ago.
  - NORA and early adopters have been testing B100 in the lab and field.
  - UL plans to finalize the standard for B100 this month.
- We are seeing an unprecedented level of commitment from appliance manufacturers and oil dealers.

Decarbonization that's Practical

- Today, I believe the oil-heating industry has the most aggressive of all decarbonization strategies for home heating.
- We now have a Net Zero house – utilizing the existing heating system.
- 575,000 homes in CT could immediately transition to B20 with no cost to the consumer.

Carlin® Combustion Technology HYDROLEVEL COMPANY

An Often Overlooked Fact:

- The most common oil heat appliance is a boilers (not a furnace)
- We estimate that over 70% of the 575,000 oil heated homes in CT are heated with boilers.
- Houses with boilers have no heating ducts
- There is no practical heat-pump replacement for a boiler. Air to water heat pumps cannot supply the needed 180°F water temp.

Biofuel Provides CT a Significant Opportunity for Decarbonization

- Like it or not, oil is going to be around at least for a while longer – So let's make it as clean as we can . . . *CT should accelerate the adoption timeline for increased B20 and increased Bio-blends.*

The ~~Oil Heat~~ Liquid Fuels Industry Is Changing

- It started slow, but momentum has grown.
- More than ever before, I see a commitment among industry leaders to drive the industry to a carbon free solution for home heating that's both dependable and affordable.

RNG Coalition

Biomethane, Syngas, and Renewable Hydrogen

Technology & Policy Overview

PRESENTED BY: Sam Lehr

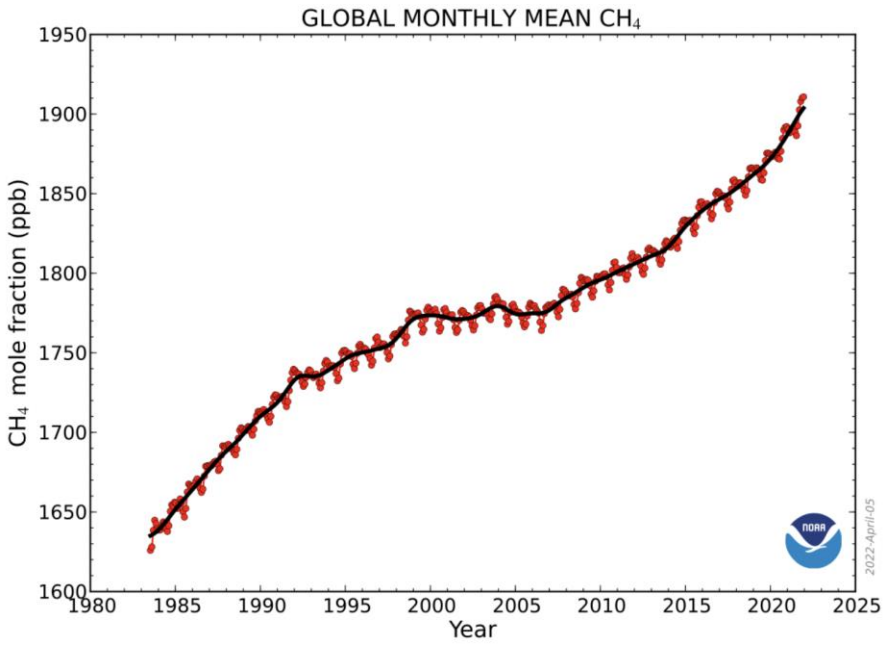
4.11.2022

About the RNG Coalition

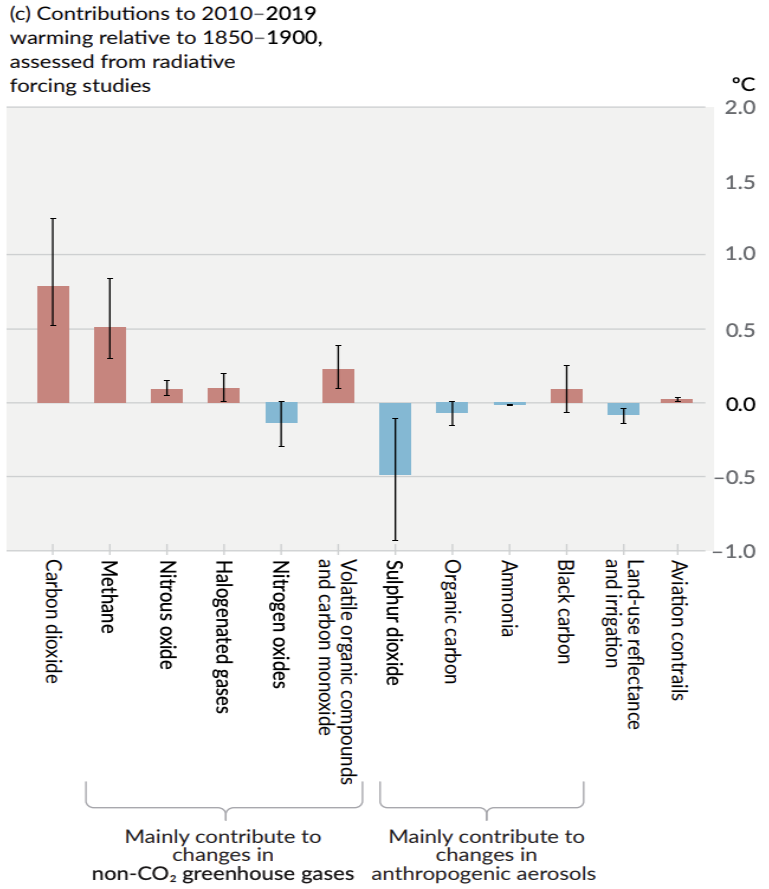
- The leading advocacy and education voice for RNG in North America
- We advocate for the sustainable development, deployment and utilization of renewable natural gas so that present and future generations will have access to domestic, renewable, clean fuel and energy
- 370+ members including: RNG developers, marketers, financiers, technology providers, consultants, utilities and labor coming together
- 98%+ of the RNG supply in North America

RNG Captures Methane from Organic Waste and Puts it to Productive Use

Intergovernmental Panel on Climate Change (IPCC) Says that Reducing Methane is a Critical Near-term Climate Strategy



CH4 trend: This graph shows globally-averaged, monthly mean atmospheric methane abundance determined from marine surface sites since 1983. Values for the last year are preliminary. (NOAA Global Monitoring Laboratory)

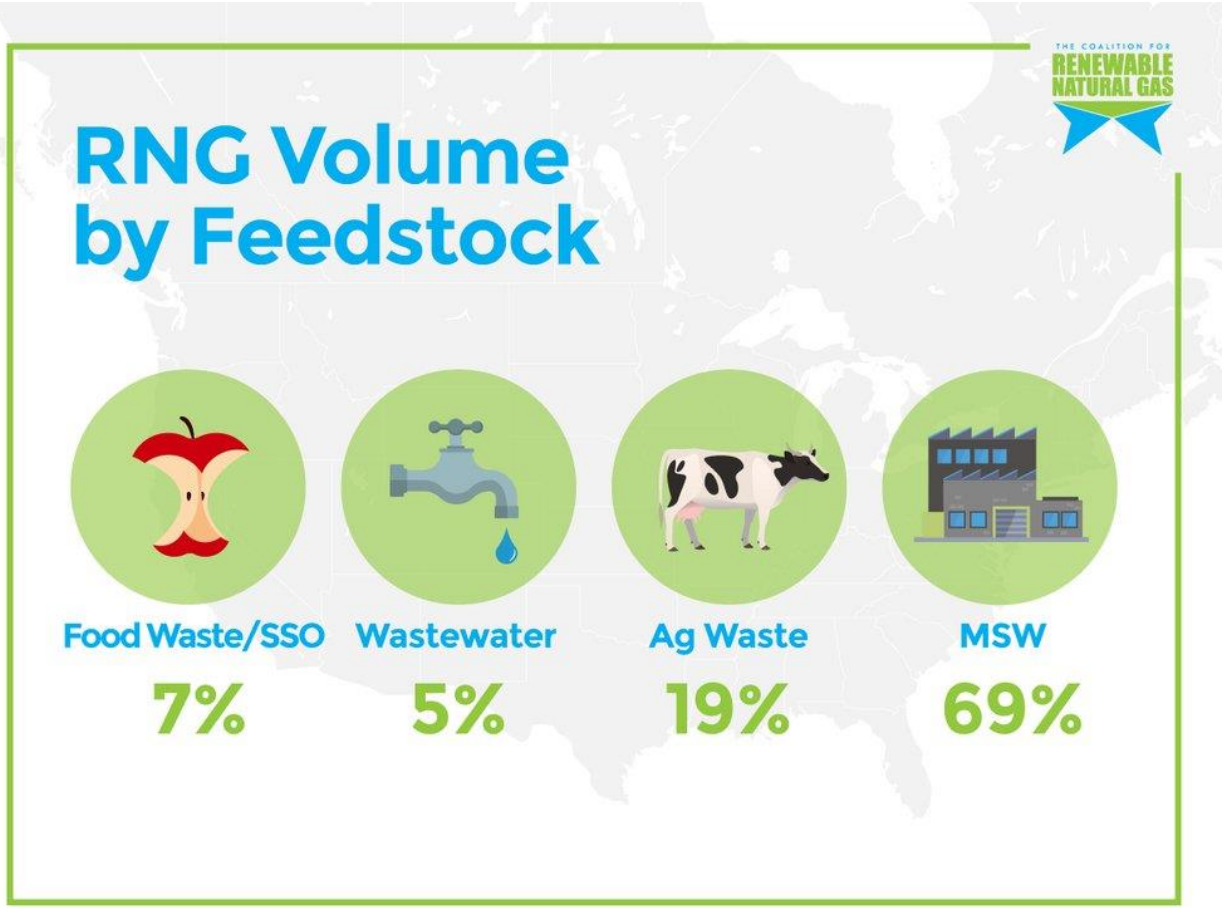


- Methane in the atmosphere continues to grow rapidly
- Second most impactful greenhouse gas (GHG) after carbon dioxide (CO_2)
- Methane is short-lived (relative to CO_2) but has a very strong warming impact (80x) in the first 20 years
- Sectors producing the largest methane emissions globally: fossil fuel production and distribution, agriculture and waste management

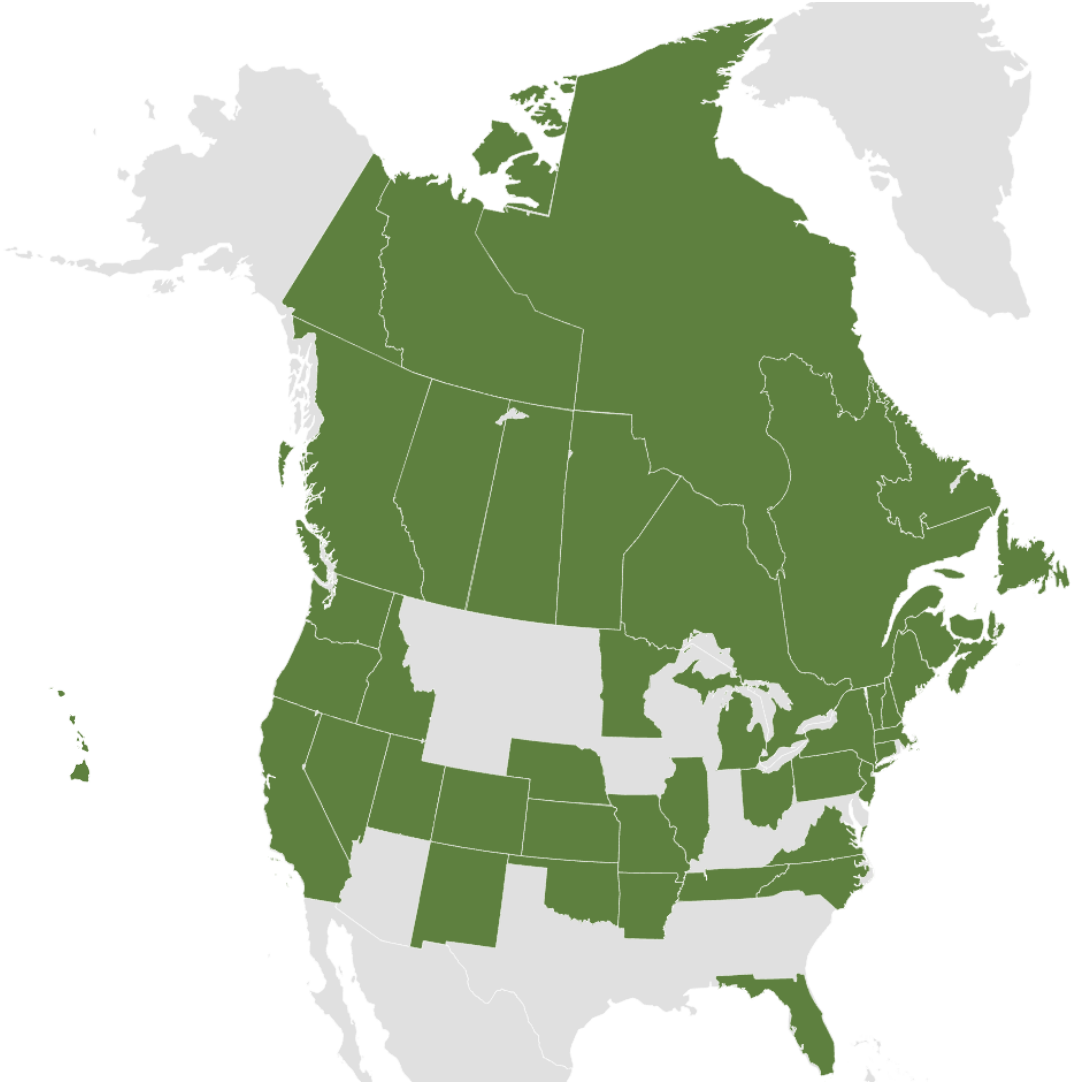
Organic Waste-to-X

- Thermal
- Transportation
- Electricity
- Hydrogen
- Bio-based Products

Where Does RNG Come From Today?



Status of Procurement Policy



RNG at a Glance:

- Mandatory, voluntary, and other enabling policies in 44 states and provinces
- 94.8 tBtu/yr production capacity
- 82.7 tBtu/yr planned
- 1,425.3 – 4,300 tBtu/yr from AD achievable by 2040

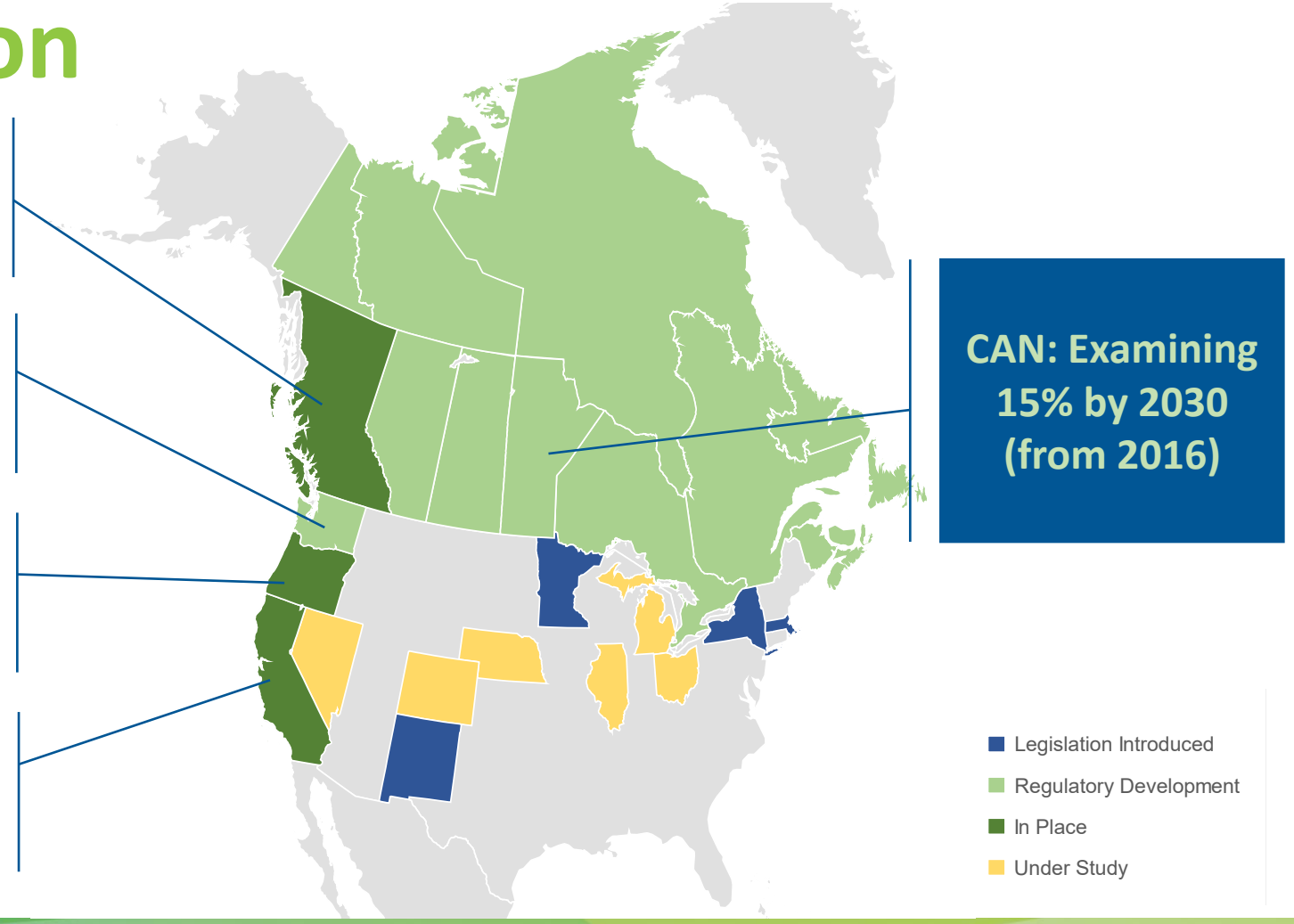
Low Carbon/Clean Fuel Standards Continue to Expand, Existing Programs Focusing on Increases in Ambition

BC: Committed 30% by 2030 (from 2010)

WA: Examining up to 20% by 2034 (from 2017)

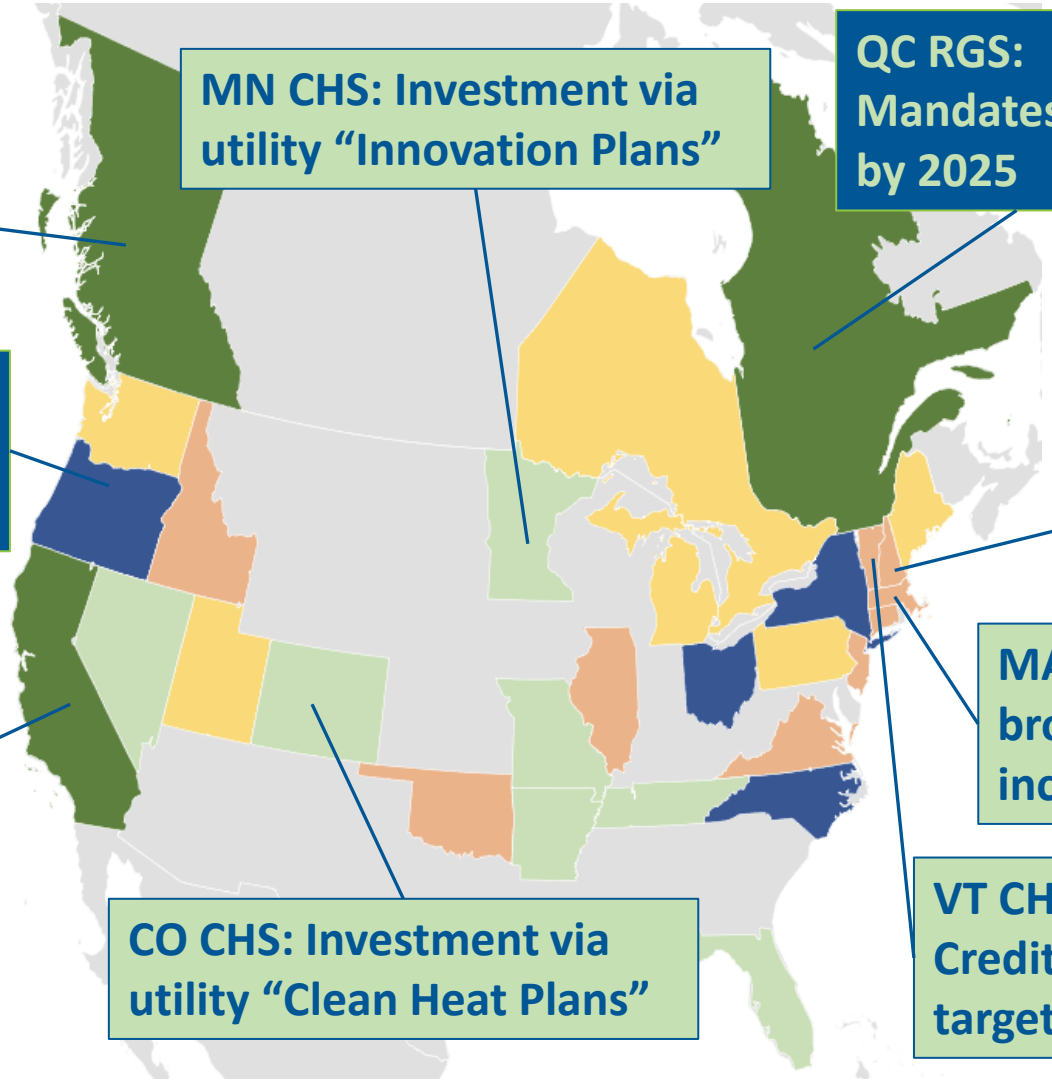
OR: Examining 20% by 2030, 37% by 2035 (from 2015)

CA: Examining at least 25% by 2030, 54% by 2035 (from 2010)



CAN: Examining 15% by 2030 (from 2016)

Renewable Gas and Clean Heat Standards



- Leg Passed, Regulatory Development (All Customers)
- In Place (All Customers and Opt-in)
- Proposed Legislation or Utility Filing
- In Place (Opt-in Customers)
- In Place (All Customers)

BC RGS: Targets 15% by 2030

OR RGS: Targets 5% by 2024, 30% by 2050

CA RGS: Mandates 12.2% by 2030

MN CHS: Investment via utility "Innovation Plans"

QC RGS: Mandates 10% by 2025

NH RGS: Allows up to 5% RNG

MA CHS: Renewable gas standard; broad renewable thermal incentives

VT CHS: Uses "Clean Heat Credits" to meet unspecified targets

CO CHS: Investment via utility "Clean Heat Plans"

Inflation Reduction Act

Contains beneficial tax policies advocated for by RNG Coalition:

- Biogas property, including cleaning and conditioning equipment, as qualifying equipment for purposes of the Section 48 energy credit
- Extension of $.50 alternative fuel tax credit
- New clean hydrogen tax credit that allows for the use of RNG as a qualifying feedstock
- 45Q carbon oxide sequestration credit

Broad Considerations

- Circular Economy – Recycling resources to create a circular economy
- Sustainability – How can RNG production facilities be used to facilitate broader change?
- Carbon Neutrality/Negativity – Eye toward full carbon neutrality across production and use through 100% clean energy inputs, use of carbon capture and storage
  - See Argonne National Lab's GREET Model
- GHG Accounting Standards – Should align across jurisdictions using established science and methodologies

Speaker Info

Sam Lehr

Manager of Sustainability and Markets Policy

RNG Coalition

sam.lehr@rngcoalition.com

(302) 757-0866

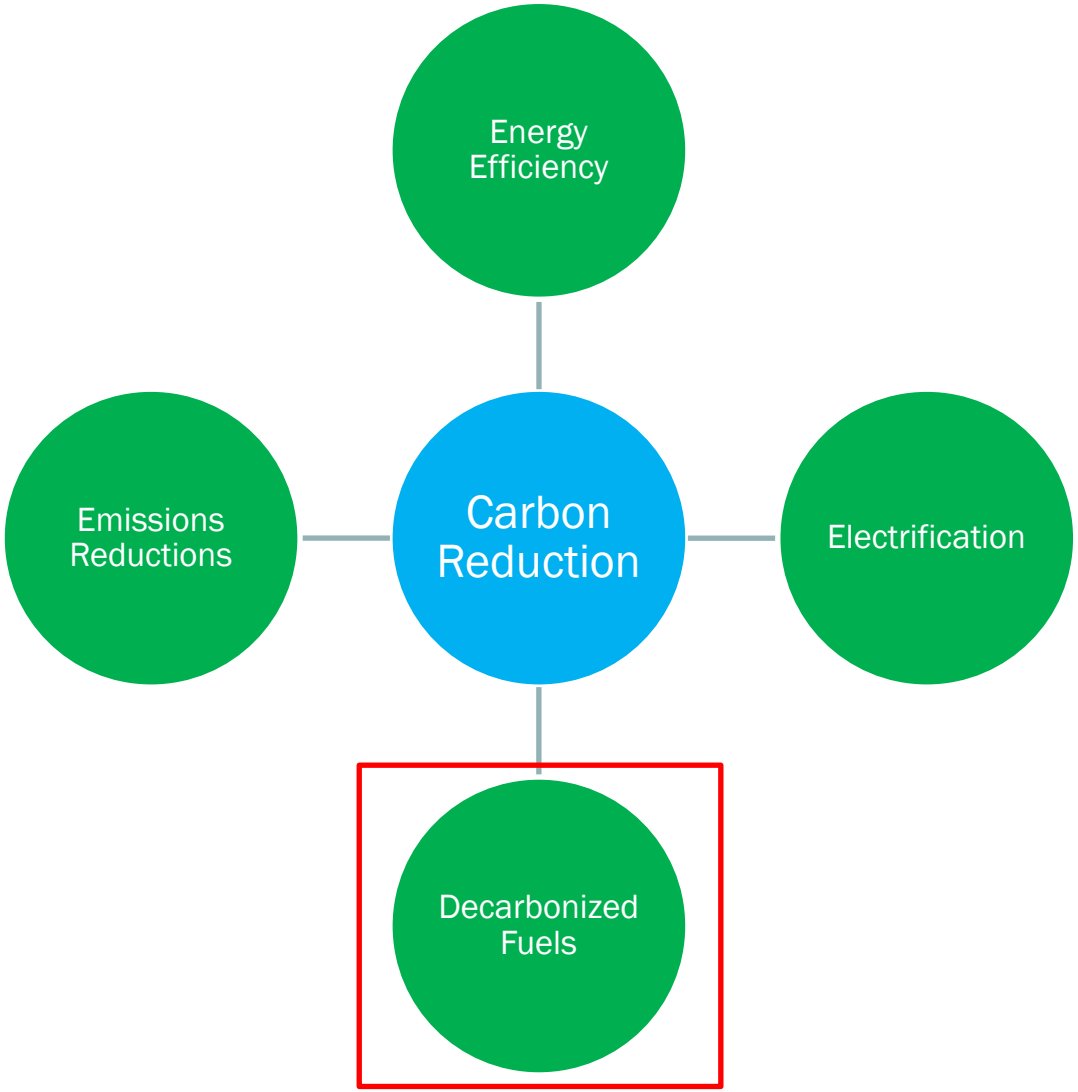
RNGCoalition.com

Eversource & Avangrid

Eversource Presentation
CES Technical Session #6
Alternative Fuels

November 4, 2022

Eversource's Net Zero Strategy



Hydrogen Overview

Types of Hydrogen

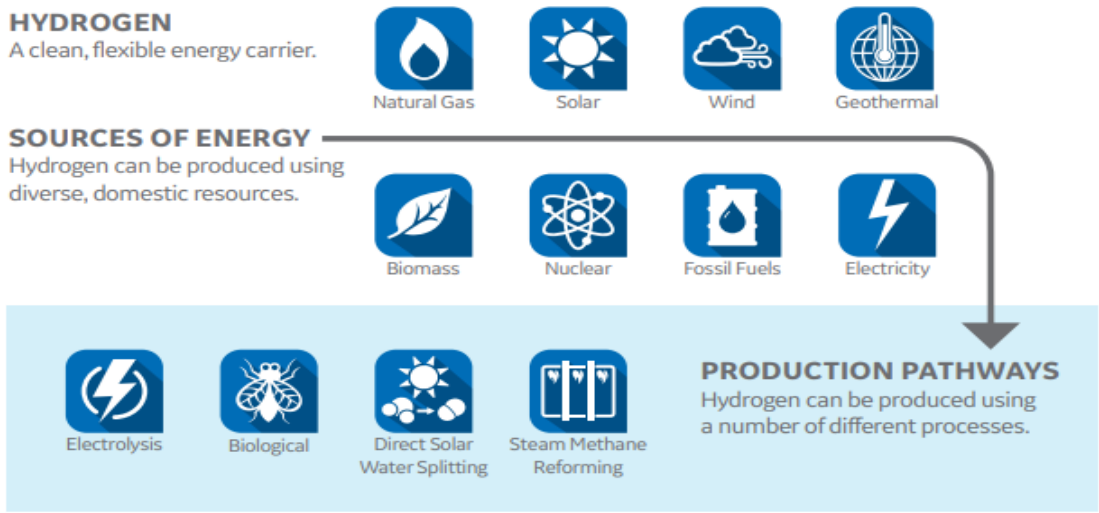
Increasing in GHG Emissions

Green
Produced using clean energy from renewable resources to electrolyze water.

Blue
Produced from natural gas through Steam Methane Reformation where CO_2 is captured and stored in the process.

Gray
Produced from natural gas through Steam Methane Reformation but CO_2 is not captured in the process.

Black/Brown
Produced from coal through gasification.



Source: GE

Gas Distribution Hydrogen Opportunities:

- Hydrogen as a fuel source for hard to electrify customers
- Aboveground or belowground storage in existing NG tanks or subsurface caverns
- Fuel cell applications for alternative power source from stored gas

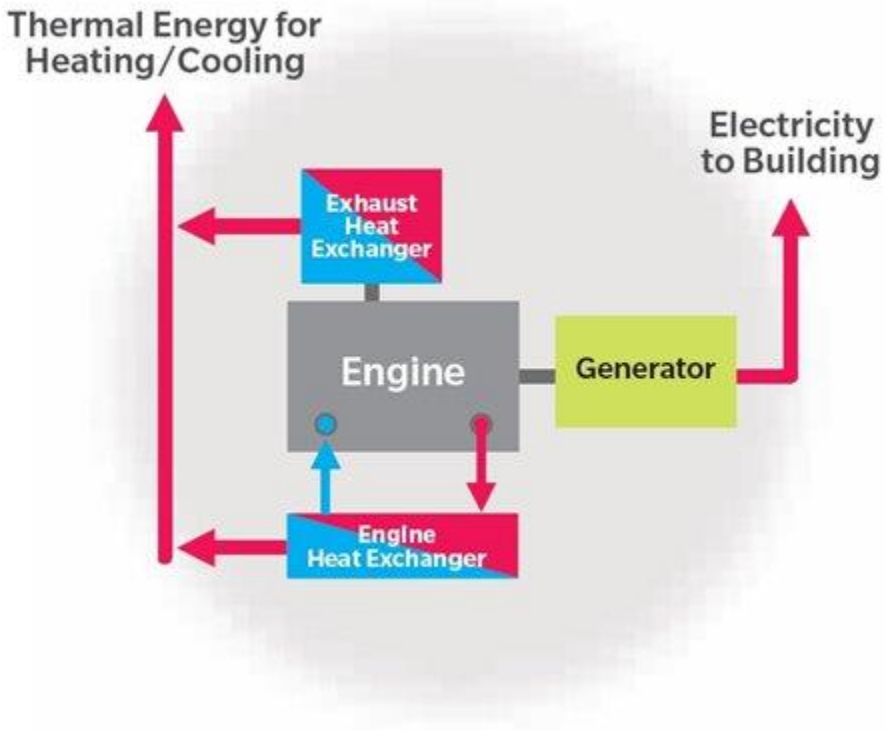
Potential Green Hydrogen Sources

- Current wind and solar projects could interface well with renewable hydrogen production
- Hydrogen could be used as an alternative long-term storage for the power generated in off-peak hours
- Experience building and operating hydrogen production facilities will be important prior to needing them for grid support.

Hydrogen End Use Opportunities

Renewable hydrogen produces no carbon emissions and can help companies reach their net zero goals

- Heat in Industrial Systems and Buildings
  - Hydrogen blending into existing boiler / furnace, up to 20%
  - Potential for 100% hydrogen pipelines with equipment conversion
- Power Generation
  - On-site CHP and back-up or emergency power
- Energy Storage
  - Compressed or liquid storage with Fuel Cell or CHP
- Transportation
  - Fuel cells in electric vehicles
  - Hydrogen machinery (Forklift, etc.)



Hydrogen Industry Development Needs

Technical
- Development and adoption of industrial equipment that can run on a blended gas
- Improving storage / transportation methods for hydrogen
- Lack of large-scale demonstration / pilot projects

Economics
- Funding approval for hydrogen initiatives
- Regulation on billing to ensure customers are charged fairly for the energy content rather than the volume
- Utility undertaking of the sale of a new product

Regulatory
- Safety regulation development and federal/state coordination
- Support for utility offerings critical for scalability
- Need for standardization and oversight

AVANGRID
CES Technical Session #6
Alternative Fuels

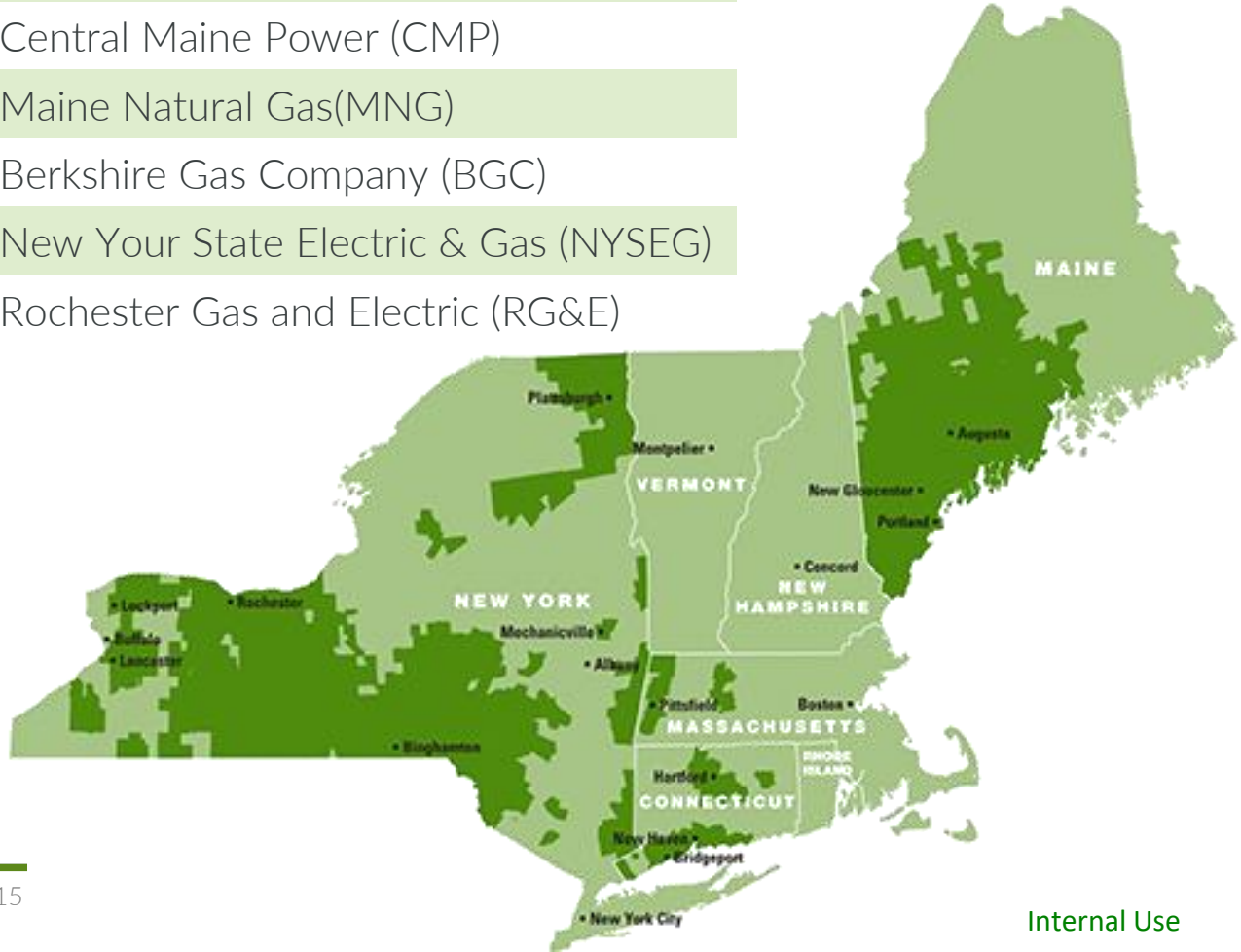
Business Development

November 4, 2022

AVANGRID

AVANGRID's Decarbonization Strategy

- Connecticut Natural Gas (CNG)
- Southern Connecticut Gas (SCG)
- United Illuminating (UI)
- Central Maine Power (CMP)
- Maine Natural Gas(MNG)
- Berkshire Gas Company (BGC)
- New Your State Electric & Gas (NYSEG)
- Rochester Gas and Electric (RG&E)



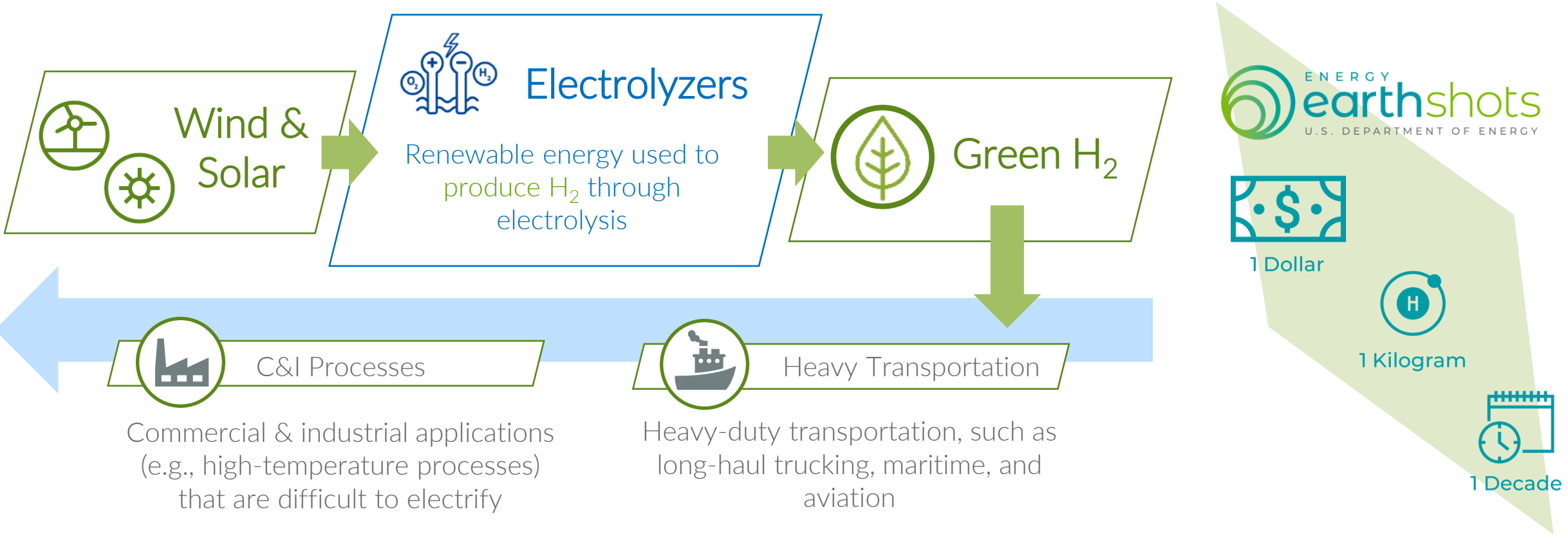
Better Climate™ CHALLENGE
U.S. DEPARTMENT OF ENERGY
PARTNER

AVANGRID Is Driving Real-World Action Toward A Low-Carbon Future

- Deploying wind & solar nationwide
- Pioneering offshore wind in U.S.
- Building a stronger, more resilient grid
- Enabling new technologies: **Clean Hydrogen**, RNG

AVANGRID's View on Green Hydrogen (H_2)

Decarbonization goals will require the use of new technologies such as green H_2



Our long-term strategy will leverage our assets and Iberdrola's experience in Europe and the UK

There is significant policy support for clean H_2

Infrastructure Investment & Jobs Act (Nov '21)

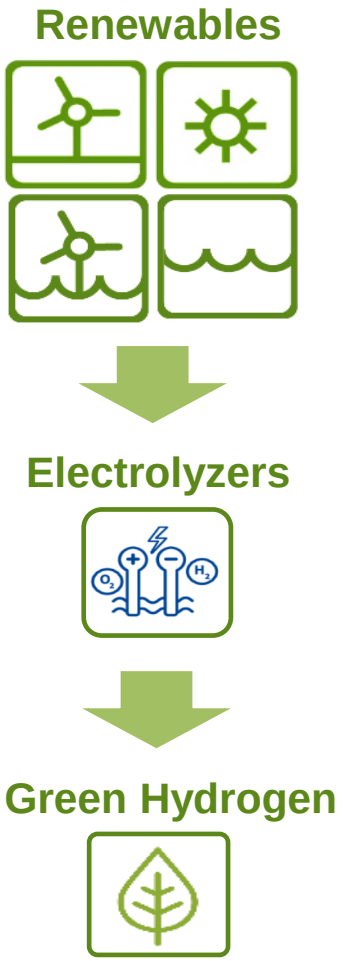
- **$8B funding opportunity** for Regional Clean H_2 Hubs
- DOE share: min range **$400-500M** to **$1-1.25B per Hub**
  - Min. **50% non-federal** share
- Hub made up of production (min. 50-100 tpd), connective infrastructure (storage/delivery), end-use
- 6-10 Hubs to be selected in the first launch
- **$1B funding opportunity** for Clean Hydrogen Electrolysis

Inflation Reduction Act (Aug '22)

- Up to **$3/kg Production Tax Credit** (PTC) for up to 10 years, OR 30% Investment Tax Credit (ITC)
- Clean H_2 sold/facilities constructed between **2023-33**

Source: Regional Clean Hydrogen Hubs Funding Opportunity Announcement, US DOE

AVANGRID's Value Proposition to Customers and Partners



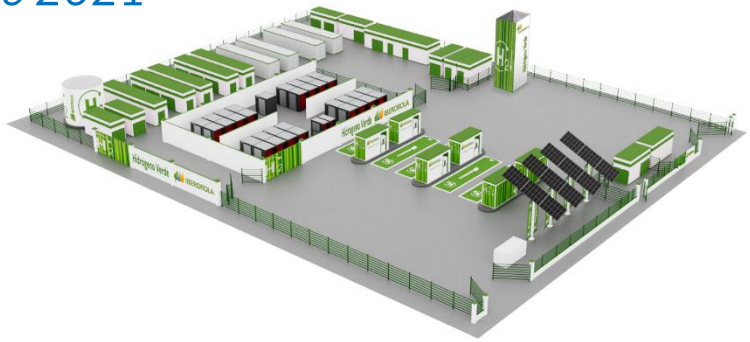
1. Reliable Green H_2 Supply (Hydrogen Purchase Agreement)
   - Zero greenhouse gas emissions
   - Custom design facility for required supply conditions
   - Leveraging our experience with real green H_2 projects
2. Reliable, Available Renewable Power
   - Operational assets in more than 25 states with large growth pipeline
3. Long Term Contracts → Price Predictability
4. Collocation with our Assets or the Consumer
5. Asset Ownership and Management
   - Co-development flexibility

Iberdrola Targeting 3.4 GW of Electrolyzer Capacity by 2030

IBERDROLA IS A FIRST MOVER WITH TWO GREEN H_2 PROJECTS OPERATING IN SPAIN

TMB (2.5 MW for Transit Buses)

COD Dec 2021



Puertollano I (20 MW for Green Ammonia)

COD Jan 2022

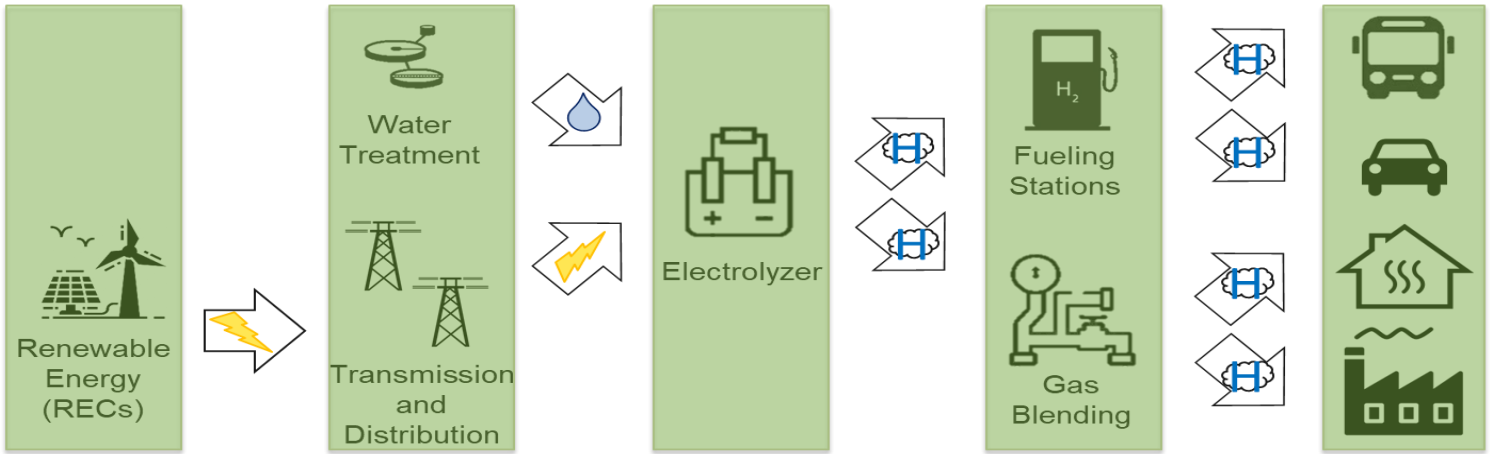
Investment € 150 M

Up to 700 local jobs

Avoided emissions 60,000 tCO_2 /year

Avangrid and Hydrogen in Connecticut

- Connecticut has the potential to become the US Capital of Hydrogen Economy.
- Connecticut is the home to major fuel cell/electrolyzer technology providers.
- Connecticut has a large pipeline of offshore wind resources to be connected to its electric system.
- Avangrid has the resources and expertise to enable Connecticut to reach its full potential spearheading the hydrogen economy in the US.
- Avangrid could deploy electrolyzers in Connecticut that will be powered with clean energy to produce carbon free hydrogen for:
  - Third party hydrogen fueling stations across the state
  - Blending in C&I processes
  - Industrial feedstock



Next Steps

- Close coordination between **industry players** and the **legislature** will enable innovative regulation to guide the development of a hydrogen ecosystem at scale in Connecticut
- Incentives around **electricity cost** should be considered by the state as it represents the primary driver to achieve competitiveness with traditional sources of hydrogen
- **Brownfield locations** should be incentivized, and site **remediation costs** should be alleviated to encourage the buildout of a hydrogen infrastructure
- Incentives should be put in place for **consumers** of hydrogen and **technology providers** to incentivize a market in Connecticut
- **Collaboration** is key to scale the business and provide a green **H2 superhighway** for heavy duty transportation

Propane Gas Association of New England

Propane's Role in Reducing Carbon Emissions

Propane Gas Association of New England
Leslie Anderson, President and CEO, Leslie@pgane.org

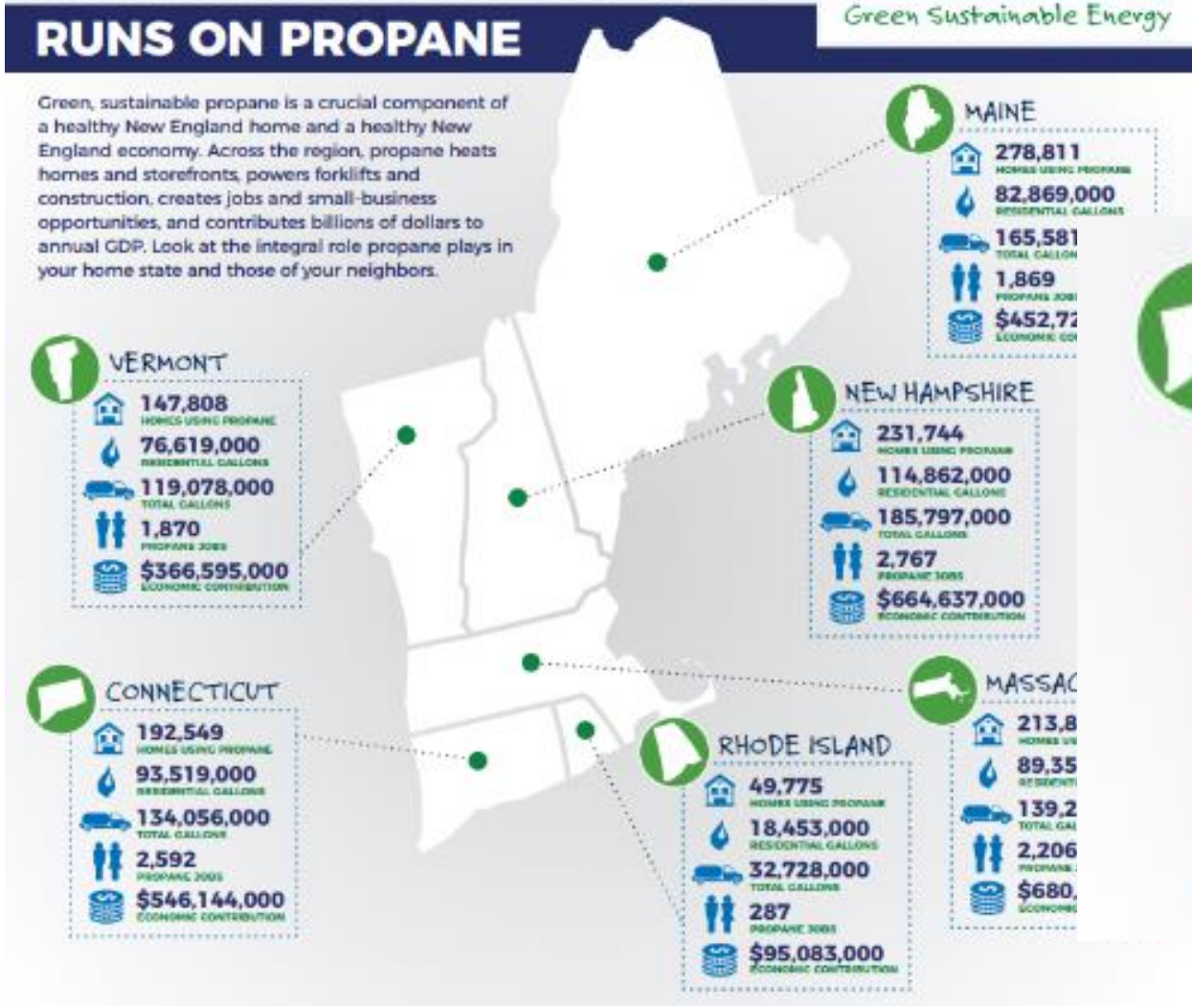
PGANE
Green Sustainable Energy

NEW ENGLAND'S ECONOMY

RUNS ON PROPANE

PGANE
Green Sustainable Energy

Green, sustainable propane is a crucial component of a healthy New England home and a healthy New England economy. Across the region, propane heats homes and storefronts, powers forklifts and construction, creates jobs and small-business opportunities, and contributes billions of dollars to annual GDP. Look at the integral role propane plays in your home state and those of your neighbors.



MAINE
- 278,811 HOMES USING PROPANE
- 82,869,000 RESIDENTIAL GALLONS
- 165,581 TOTAL GALLONS
- 1,869 PROPANE JOBS
- $452,72 ECONOMIC CONTRIBUTION

VERMONT
- 147,808 HOMES USING PROPANE
- 76,619,000 RESIDENTIAL GALLONS
- 119,078,000 TOTAL GALLONS
- 1,870 PROPANE JOBS
- $366,595,000 ECONOMIC CONTRIBUTION

NEW HAMPSHIRE
- 231,744 HOMES USING PROPANE
- 114,862,000 RESIDENTIAL GALLONS
- 185,797,000 TOTAL GALLONS
- 2,767 PROPANE JOBS
- $664,637,000 ECONOMIC CONTRIBUTION

CONNECTICUT
- 192,549 HOMES USING PROPANE
- 93,519,000 RESIDENTIAL GALLONS
- 134,056,000 TOTAL GALLONS
- 2,592 PROPANE JOBS
- $546,144,000 ECONOMIC CONTRIBUTION

MASSAC
- 213,8 HOMES US
- 89,35 RESIDENTIAL
- 139,2 TOTAL GA
- 2,206 PROPANE
- $680, ECONOMIC

RHODE ISLAND
- 49,775 HOMES USING PROPANE
- 18,453,000 RESIDENTIAL GALLONS
- 32,728,000 TOTAL GALLONS
- 287 PROPANE JOBS
- $95,083,000 ECONOMIC CONTRIBUTION

CONNECTICUT

192,549
HOMES USING PROPANE

93,519,000
RESIDENTIAL GALLONS

134,056,000
TOTAL GALLONS

2,592
PROPANE JOBS

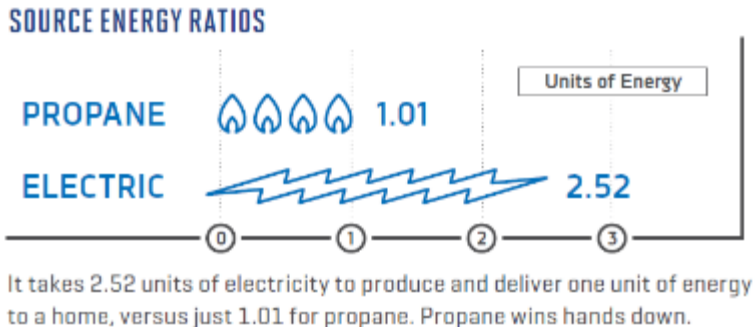
$546,144,000
ECONOMIC CONTRIBUTION

Propane is a Beneficial By-Product

- Propane itself is fundamentally a waste left over from natural gas and petroleum production.
- More propane is produced annually than is consumed, with the remainder being flared off at the well head or the processing plant.
- The use of propane as an Autogas, heating source or back-up fuel is essentially carbon neutral, since propane not used is wasted by flaring which has the same or greater carbon impact than using propane
- Use it or lose it : A better use of propane is to utilize it, which will offset the carbon emissions from another energy source.

Propane is one of the good energies.

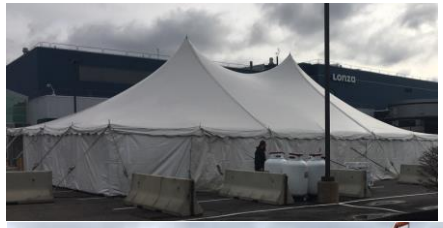
- A propane storage tank and its accessories, which is like a massive electric storage battery, is 100% recyclable at the end of its useful life
- Propane is non-toxic and hydrogen rich C3H8
- Propane has no ozone-depleting chemicals
- Propane has no methane
- Propane's source energy is less than electricity



PGANE
Green Sustainable Energy

888-445-

Sustainability, Resiliency, and Energy Diversity
Propane is the Unsung Energy Hero









PGANE
Green Sustainable Energy

Sustainability, Resiliency, and Energy Diversity
Transportation Carbon Emission Reductions

Environmental Justice

- Stable Pricing
- Affordable
- Low infrastructure Costs
- No Batteries

Understanding Carbon Intensity
GHG Footprint of Electricity

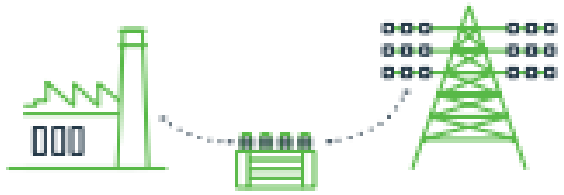
Extraction

Electricity is not naturally occurring, so it must be produced using other resources like gas, coal, or nuclear.

approximately 9.9% CO2 eq emissions

Carbon intensity score:

15.2 g/MJ



Generation

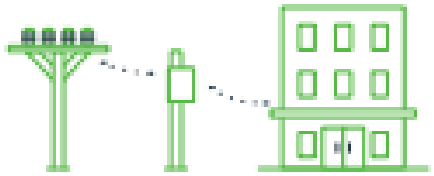
Power plant generates electricity.

Transformer steps up voltage for transmission.

approximately 75.6% CO2 eq emissions

Carbon intensity score:

116.5 g/MJ



Transmission & Distribution

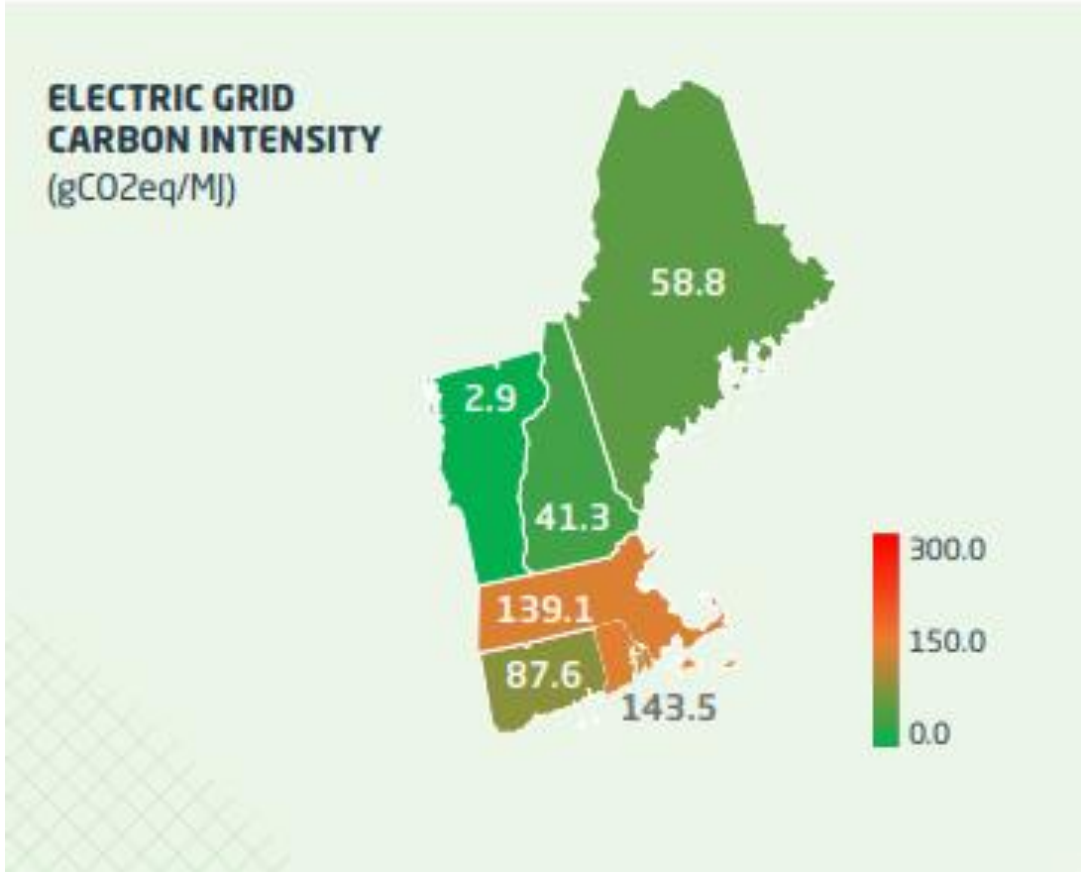
The transmission lines carry electricity to transformers, which step down voltage. Electricity is delivered to the charging location.

approximately 4.5% CO2 eq emissions

Carbon intensity score:

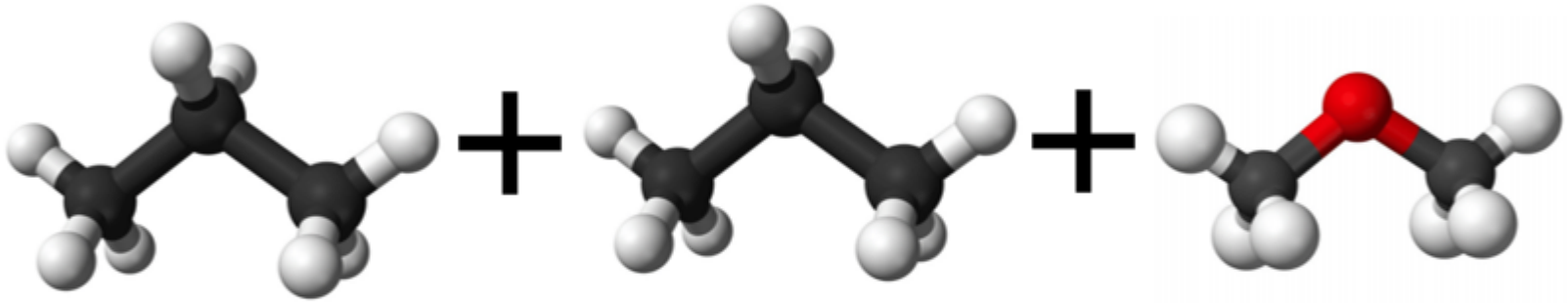
7 g/MJ

Making a Clean Energy Cleaner
Conventional Propane CI = 80
Renewable Propane CI = 20



Carbon Neutral Propane Cocktail

80 gCO2eq/MJ | 20.5 gCO2eq/MJ | -278 gCO2eq/MJ



Conventional
~30% by mass

Renewable
(NA Sourced used cooking oil)
~50% by mass

Renewable
(Dairy gas based)
~20% by mass

~0 gCO2eq/MJ

Understanding the Blends

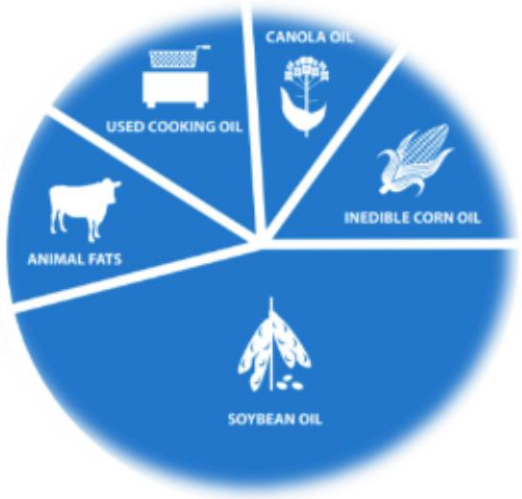
CONVENTIONAL PROPANE (LPG)
80 gCO2eq/MJ
Sometimes known as liquefied petroleum gas or LPG , propane is a gas normally compressed and stored as a liquid, and a byproduct of natural gas processing and oil refining.

RENEWABLE PROPANE (RP)
20.5 gCO2eq/MJ
Unlike conventional propane, renewable propane is made from a variety of renewable feedstocks, with even lower carbon emissions when compared with other energy sources.

RENEWABLE DIMETHYL ETHER (RDME)
-278 gCO2eq/MJ
rDME is dimethyl ether produced from renewable and recycled carbon feedstock. While it has similar thermophysical properties as propane, its disparate chemical properties make it ideal for blending.

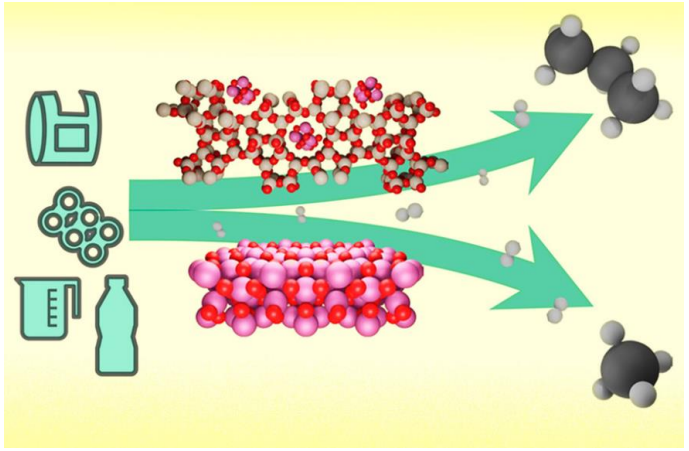
Innovation - Renewable Propane Sources

Renewable Energy Group



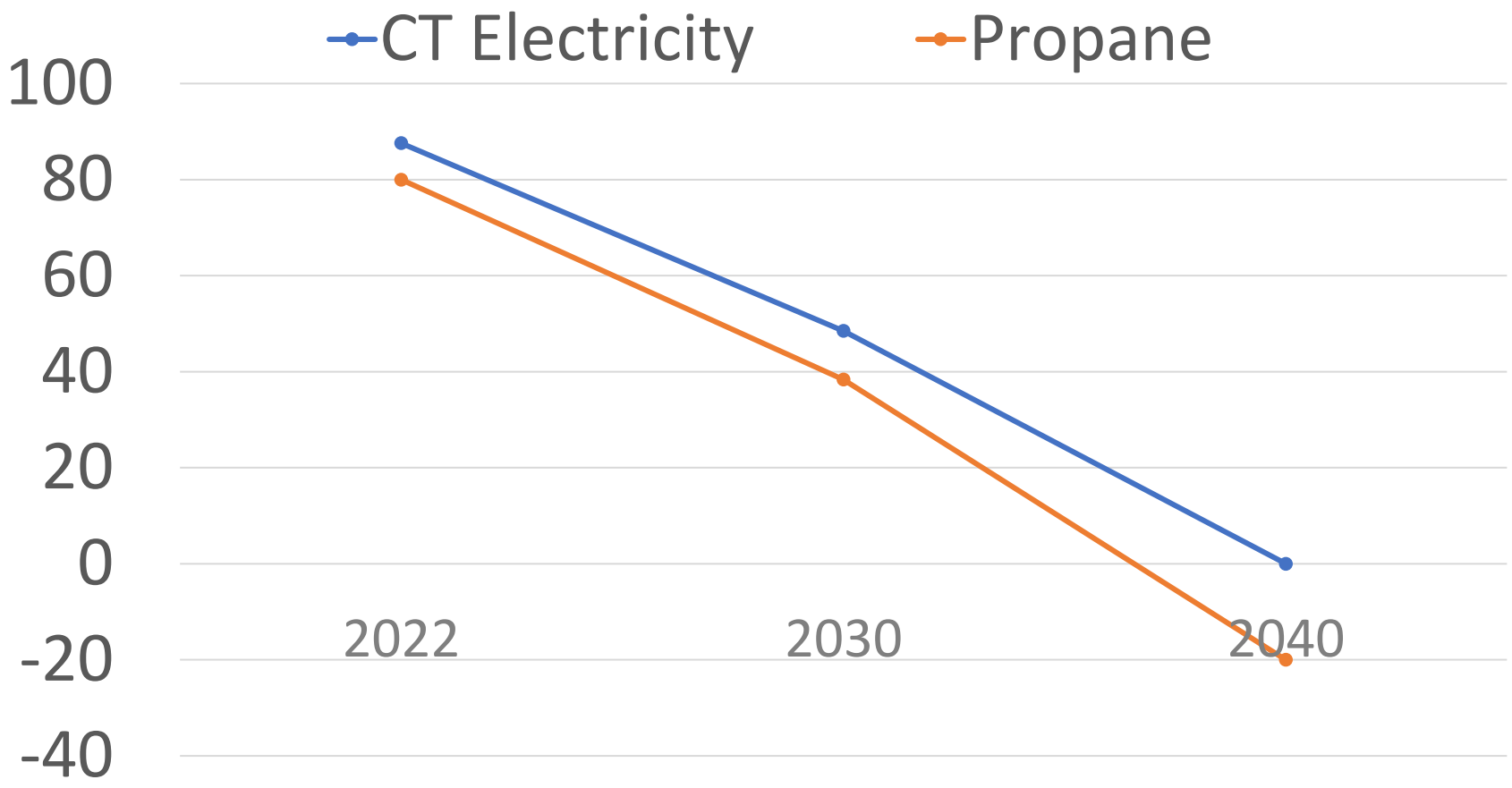
DME+ PROPANE

Dangers of Preventing Innovation



Researchers were able to selectively break down plastic molecules and turn more than 80% of them into propane for use as fuel or feedstock.

A Path to Cutting Carbon Intensity

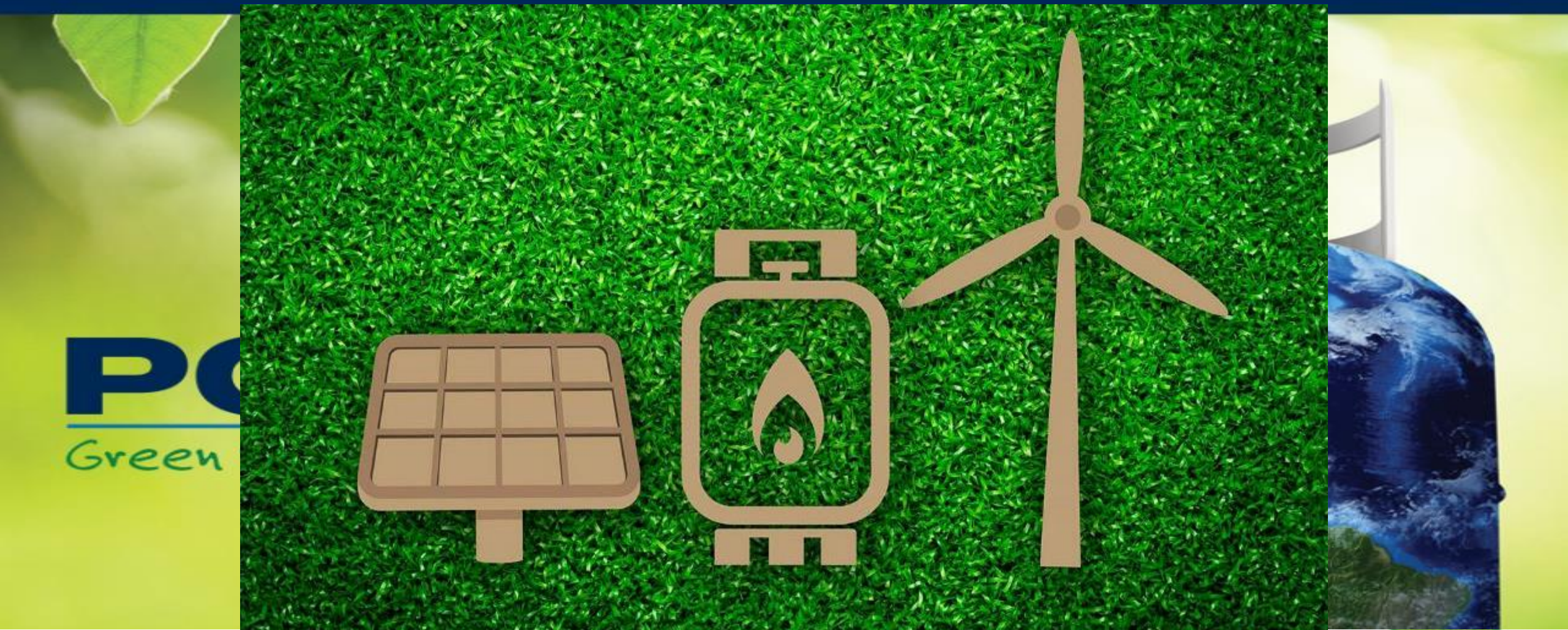


PGANE
Green Sustainable Energy

888-445-1075 | PGANE.ORG

Energy Security

Propane is the Energy of the Future



Bureau of Materials Management & Compliance Assurance – CT DEEP

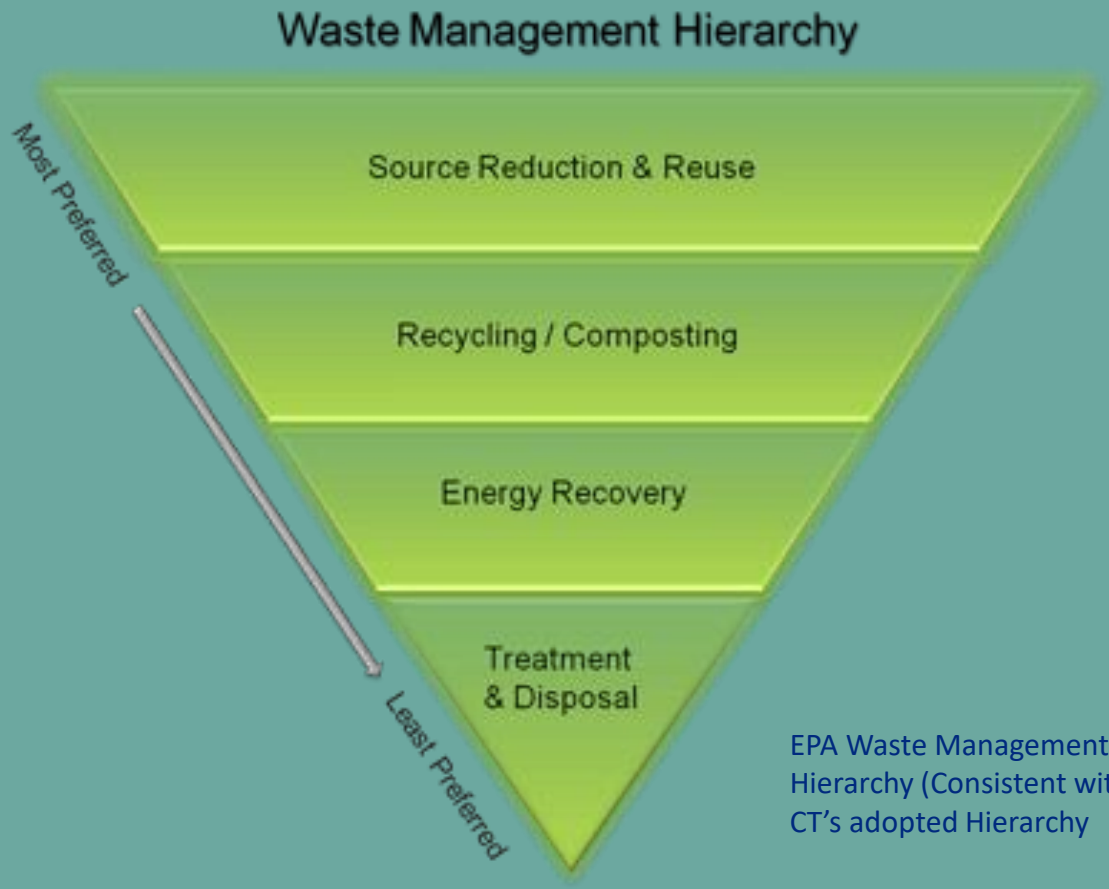
Materials Management and Alternative Fuels

November 4, 2022

Bureau of Materials Management and Compliance Assurance, CT DEEP

Waste Management Hierarchy

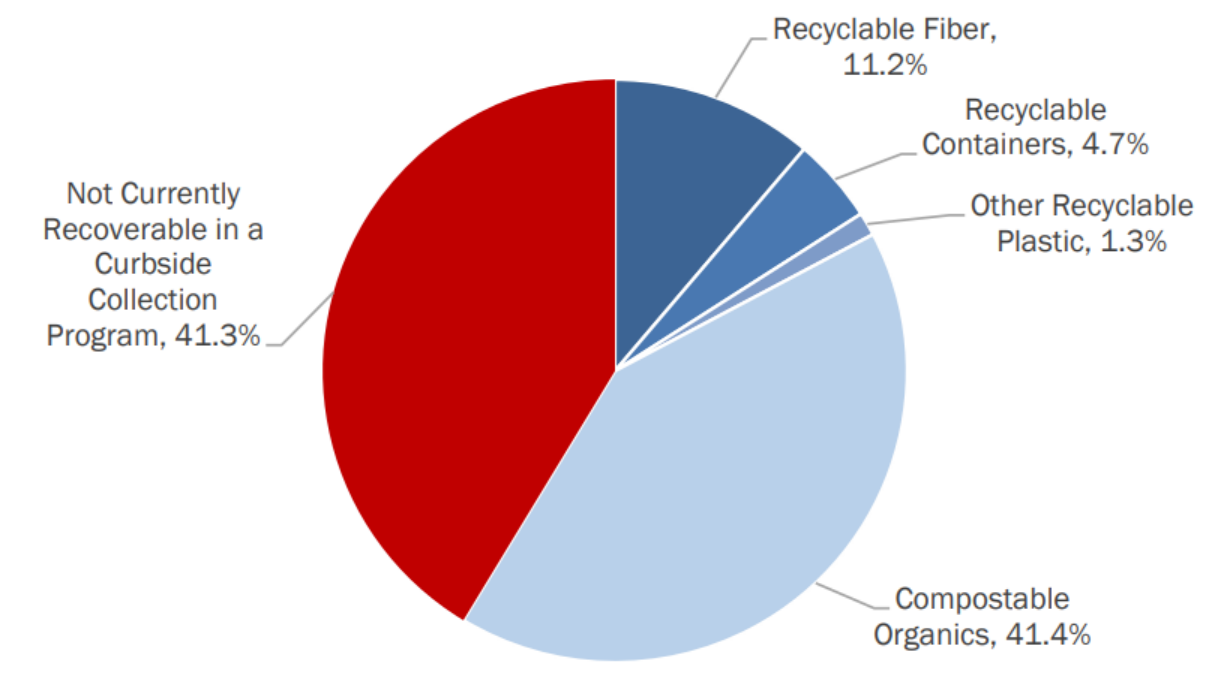
- Adopted through CGS § 22a-228(b)
- The hierarchy favors source reduction and reuse, recycling, and composting, with remaining materials managed for energy recovery, and disposal in landfill as a last resort.
- Energy recovery from waste is the conversion of waste materials into useable heat or electricity through processes including:
  - Combustion
  - Anaerobic digestion
  - Other waste conversion technology



EPA Waste Management Hierarchy (Consistent with CT's adopted Hierarchy

2015 State-wide Waste Characterization Study

Recoverability of Disposed Wastes in Existing Curbside/ On-site Collection Programs

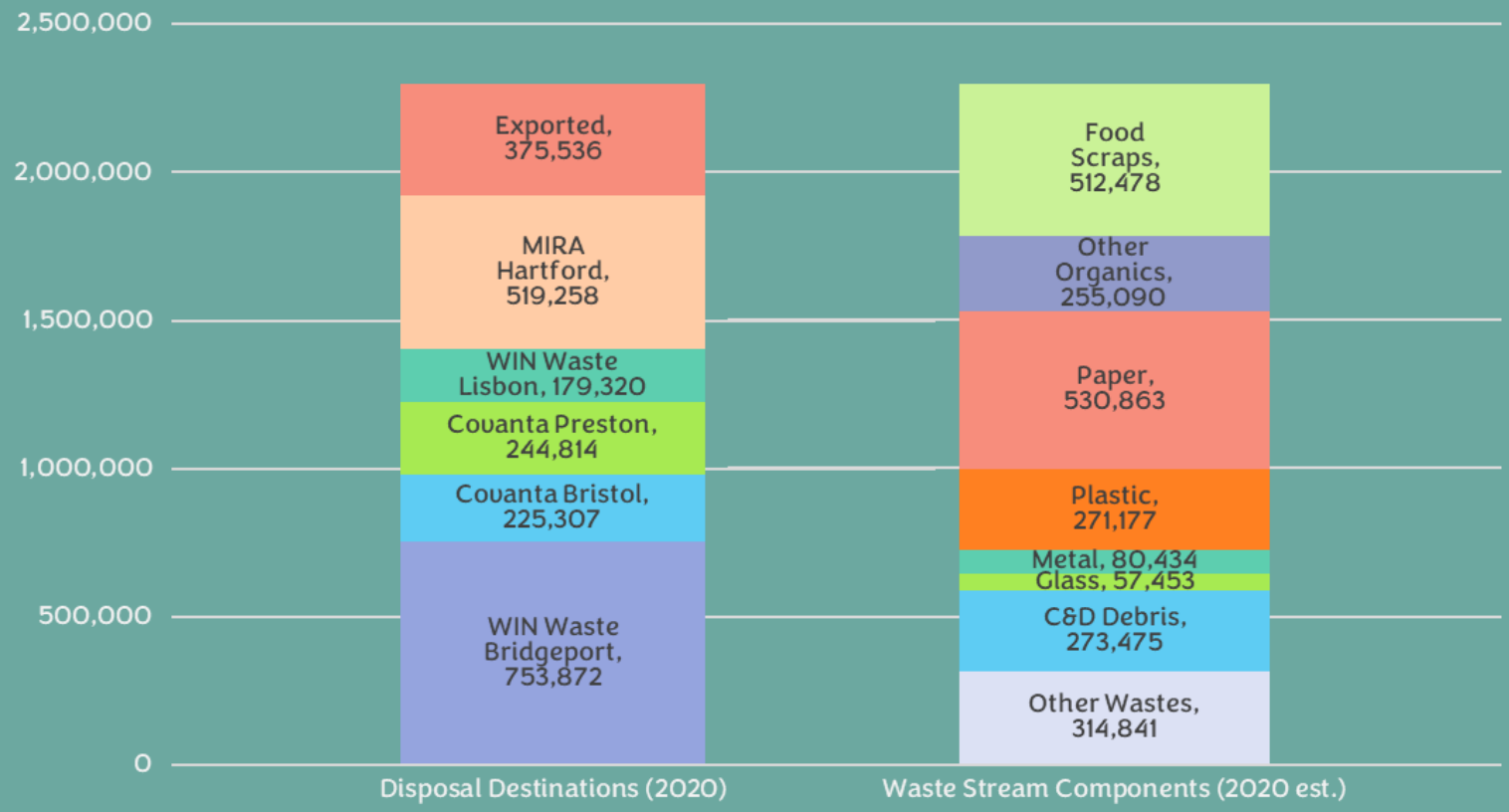


*Not currently recoverable material percentage may have shifted slightly following What's In What's Out implementation

- 2015 Waste Characterization study used random samples of waste that was bound for disposal from residential and industrial, commercial and institutional generators
- Percentages calculated by weight of sampled material
- Over 40% of waste consisted of compostable organics, including food waste and other organics (leaf/yard waste, etc.) that could be diverted

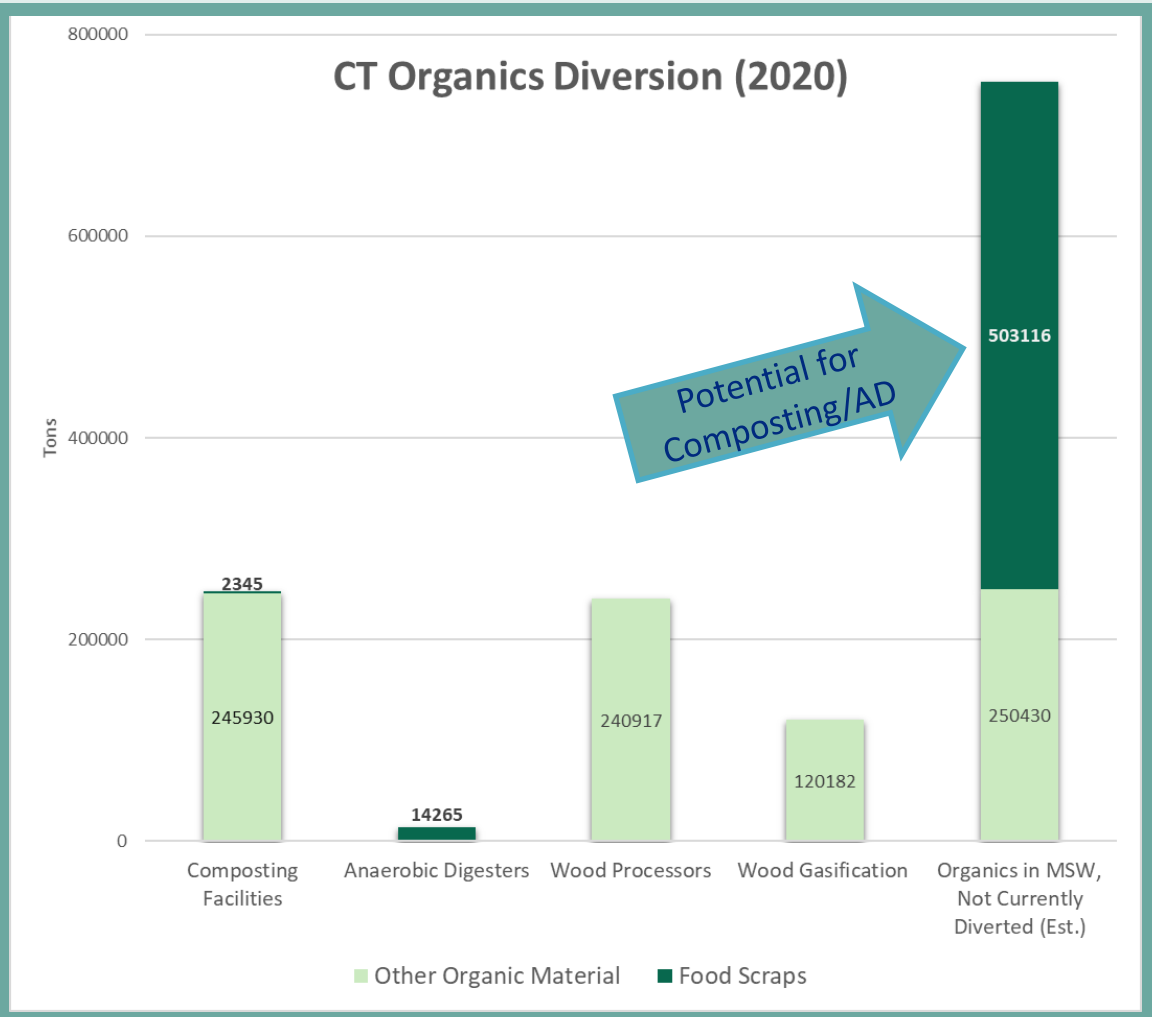
What We Throw Away and Where it Goes

- In 2020, 2.3 million tons of waste were disposed in CT's Waste-to-Energy facilities or shipped out of state
- Does not include material that was source separated for reuse, recycling, or composting
- The components of the 2020 waste stream were estimated using the percentages from the 2015 waste characterization study and tonnages from 2020



**2020 data not validated*

Potential and Actual Organics Recovery in 2020



- In 2020, CT diverted only a small portion of generated food scraps to composting and anaerobic digestion facilities
- Opportunities to divert additional 500,000 tons of food scraps out of MSW stream per year

Data Notes:

- "Other Organic Material" includes leaves, grass, yard waste, land clearing/brush, and farm waste
- Data does not include on-farm anaerobic digester operations that accept less than 40% of source material from off-site
- Material sent to wood processors is typically chipped for reuse applications or processed for energy recovery
- Wood gasification used in one CT Facility, generating average of 37.5 MW annually

**2020 data not validated*

Facilities that Generate Energy from Waste: Key Definitions

Anaerobic Digestion Facility: A facility that processes source-separated organic materials through controlled decomposition in the absence of oxygen to produce biogas and digestate.
Biogas is generated through the anaerobic digestion or fermentation process and contains methane, carbon dioxide and other elements and compounds.
Digestate is the end-product of AD processes and consists of both liquid and solid fractions.

Resources Recovery Facility (CGS Sec. 22a-207; a.k.a. Waste to Energy Facility): A facility that combusts municipal solid waste to generate electricity.

Waste Conversion Facility: (CGS Sec. 22a-207) A facility that uses thermal, chemical or biological processes to convert solid waste, including, but not limited to, municipal solid waste, into electricity, fuel, gas, chemical or other products and that is not a facility that combusts mixed municipal solid waste to generate electricity.

- Gasification
- Pyrolysis

Anaerobic Digestion (AD)

Environmental Benefits

- Diverts food scraps from WTE/ landfills
- Mitigates methane from entering atmosphere as GHG
- Allows for the metered release of nutrients into soil; mitigates over-nutrification
- Beneficial use of solid and liquid digestate as compost, animal bedding and liquid fertilizer
- Generates renewable biogas for energy generation or pipeline injection

Current Infrastructure in CT

- Four AD facilities permitted; three not built
- One commercial AD facility
  - Quantum Biopower
  - Generates 420,000 cubic ft. of biogas annually at capacity
- Three on-farm AD
  - Fort Hill Farm AgGrid, LLC.
  - Oak Ridge
  - Hytone Farm

Potential Challenges

- Sourcing adequate feedstocks
- Economic feasibility of constructing new large-scale facilities dependent on several factors, including
  - PPAs/Renewable Energy Credits,
  - tipping fees for food waste receipt,
  - marketing (revenue generation) of end products for beneficial use
  - Financers' ability/willingness to invest in projects prior to permits being issued

Waste-to-Energy

WIN Waste BRIDGEPORT

Started:	1988
Technology:	Mass Burn
Capacity (MSW):	2,250 tons per day
Boilers:	3
Elec. Capacity:	67 MW
People Served:	815,807

WIN Waste LISBON

Started:	1995
Technology:	Mass Burn
Capacity (MSW):	500 tons per day
Boilers:	2
Elec. Capacity:	15 MW
People Served:	225,000

COVANTA BRISTOL

Started:	1988
Technology:	Mass Burn
Capacity (MSW):	650 tons per day
Boilers:	2
Elec. Capacity:	16.3 MW
People Served:	373,150

COVANTA PRESTON

Started:	1991
Technology:	Mass Burn
Capacity (MSW):	669 tons per day
Boilers:	2
Elec. Capacity:	17 MW
People Served:	248,233

Source: Energy Recovery from the Combustion of Municipal Solid Waste (MSW) | US EPA

- Connecticut's primary municipal solid waste disposal management approach is energy recovery through MSW waste to energy facilities.
- The four operating facilities generate electricity through mass burn technology.
- Before closing last July, MIRA's facility used refuse derived fuel (RDF) technology, which was combusted on site to generate electricity.
- Due to the closure of the MIRA facility, MSW exported for disposal has gone up and will continue to rise until Connecticut:
  - Develops additional in-state capacity;
  - Implements effective reduction strategies;
  - Increases recycling; and/or
  - Increases reuse and recycling of food scraps

Other Technologies

Landfill Gas (LFG)

- Only two landfills currently operating in CT; primarily bulky waste
- Several CT closed landfills are collecting gas to flare but it is not economically feasible to convert to usable energy
- Only economically feasible on larger MSW landfills with substantial organic material; used out of state
- Does not capture 100% of emissions from landfills

Other Waste Conversion Technology

- Pyrolysis
- Gasification
- Others

Other Potential Sources

- Wastewater Facility Gas

Contact Information

Gabrielle Frigon
Director
Waste Engineering and Enforcement Division
Bureau of Materials Management and Compliance Assurance
gabrielle.frigon@ct.gov | P: 860.424.3795 | M: 860.372.1256

Elizabeth Moore
Environmental Analyst
Office of Policy and Planning
Bureau of Materials Management and Compliance Assurance
elizabeth.moore@ct.gov | 860.424.3567

To access DEEP assistance, begin by requesting a pre-application meeting about your project.

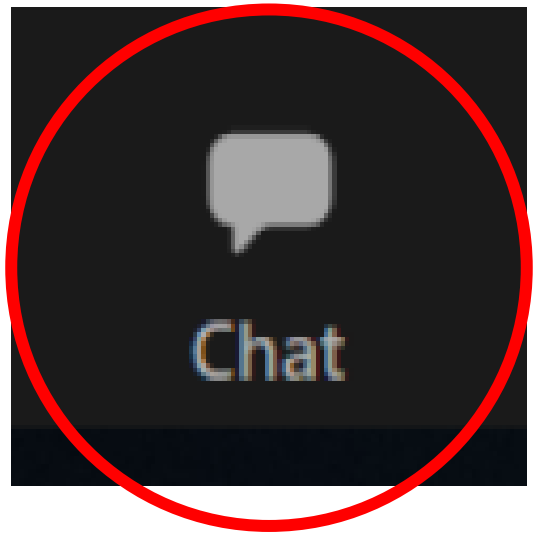
For projects that require multiple permits and are time-sensitive or complex, contact the Client Concierge Service to provide an added level of assistance through the permitting process.
DEEP Client Concierge Service: DEEP.Concierge@ct.gov

Solid Waste Permitting:
(860) 424-3366

Air Permitting:
DEEP.BAM.AirPermits@ct.gov
or (860) 424-4152

Wastewater permitting:
(860) 424-3025

Questions



At the conclusion of each panel DEEP will hold a brief question and answer period.

If you have a question for a presenter, please drop it into the chat to **Jeff Howard**. DEEP will pose as many questions as time allows to the speakers. Clarifying questions will be prioritized. Leading questions will not be accepted.

Lunch Break

(we'll restart at 1:00 p.m. ET)

BUREAU OF ENERGY AND TECHNOLOGY POLICY